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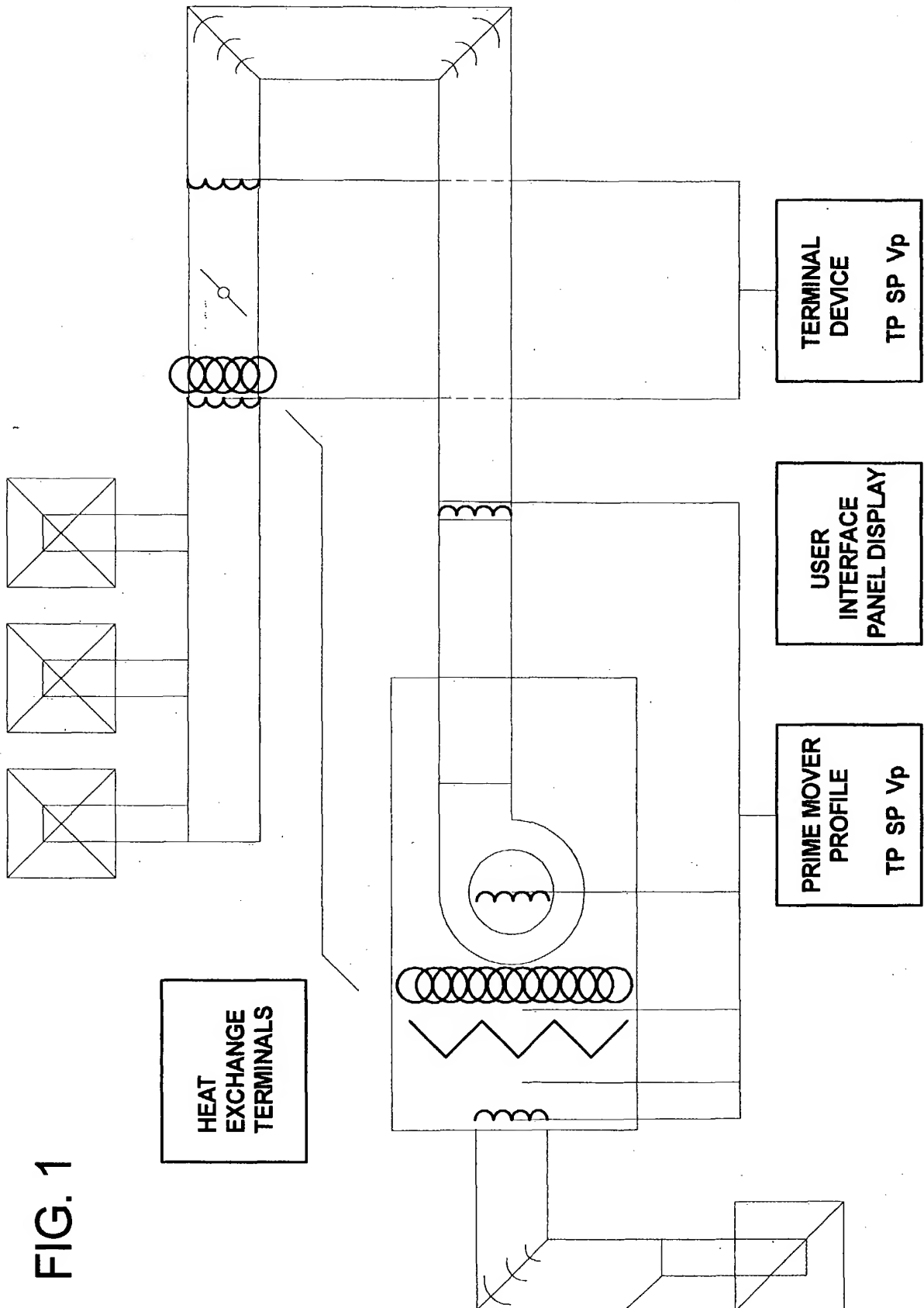


FIG. 2

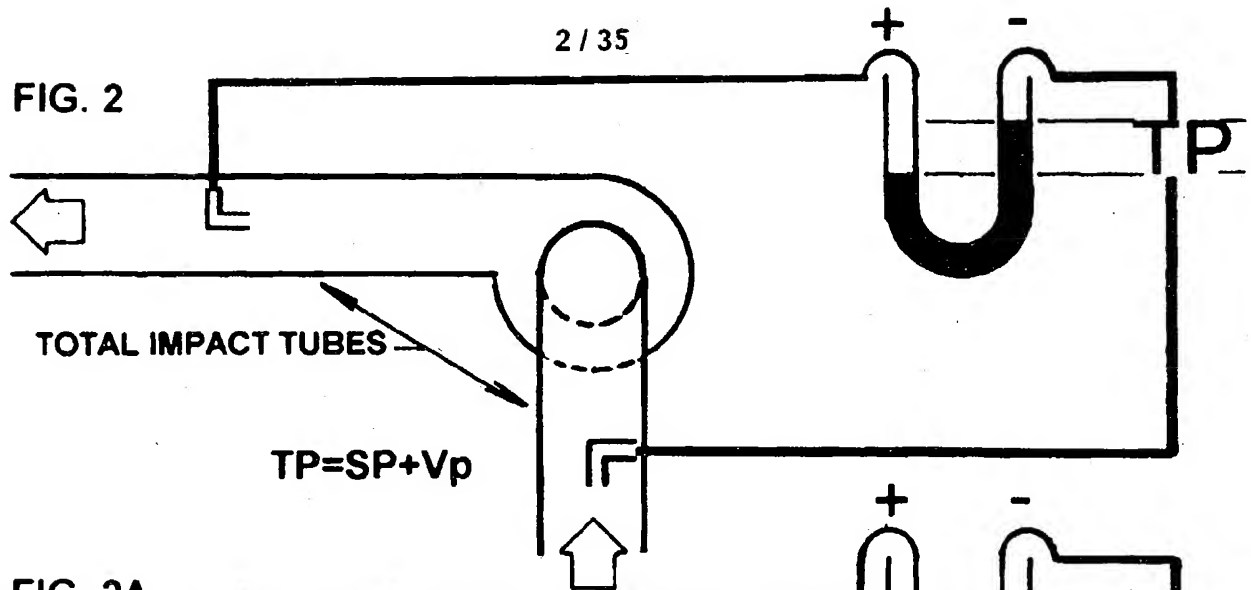


FIG. 2A

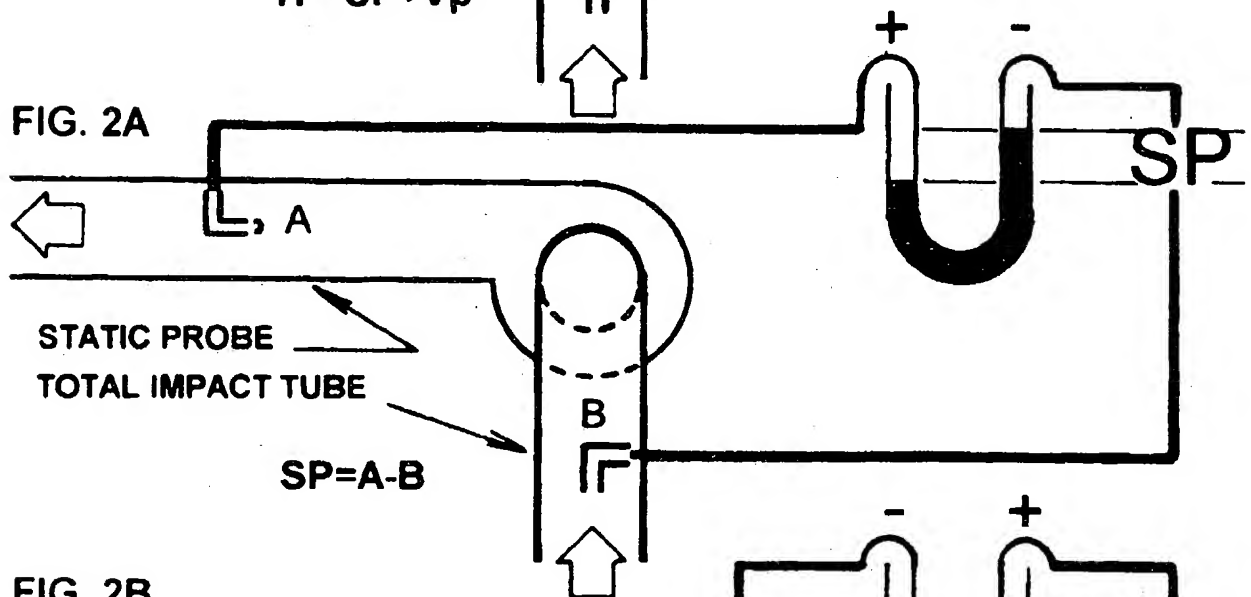
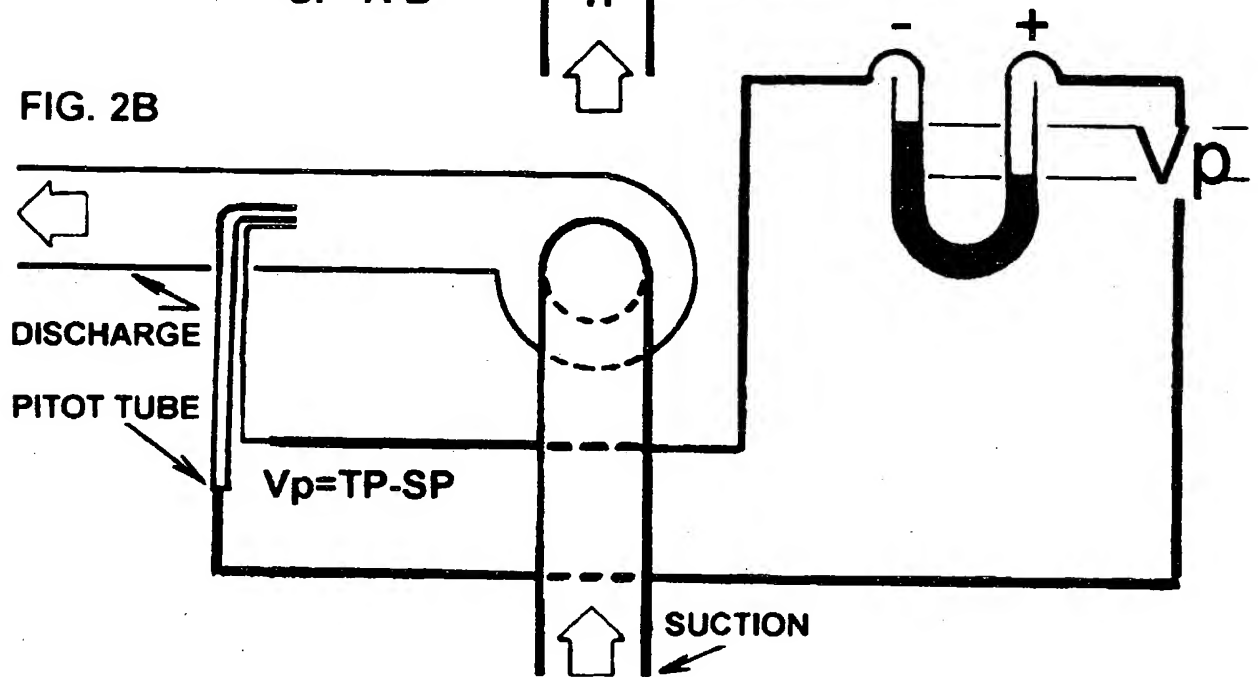


FIG. 2B



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FIG. 3

# TYPICAL DRAW-THRU UNIT

OUTDOOR  
AIR

MIXING  
BOX

RETURN AIR

FILTER  
SECTION

COIL SECTION

BLOWER SECTION

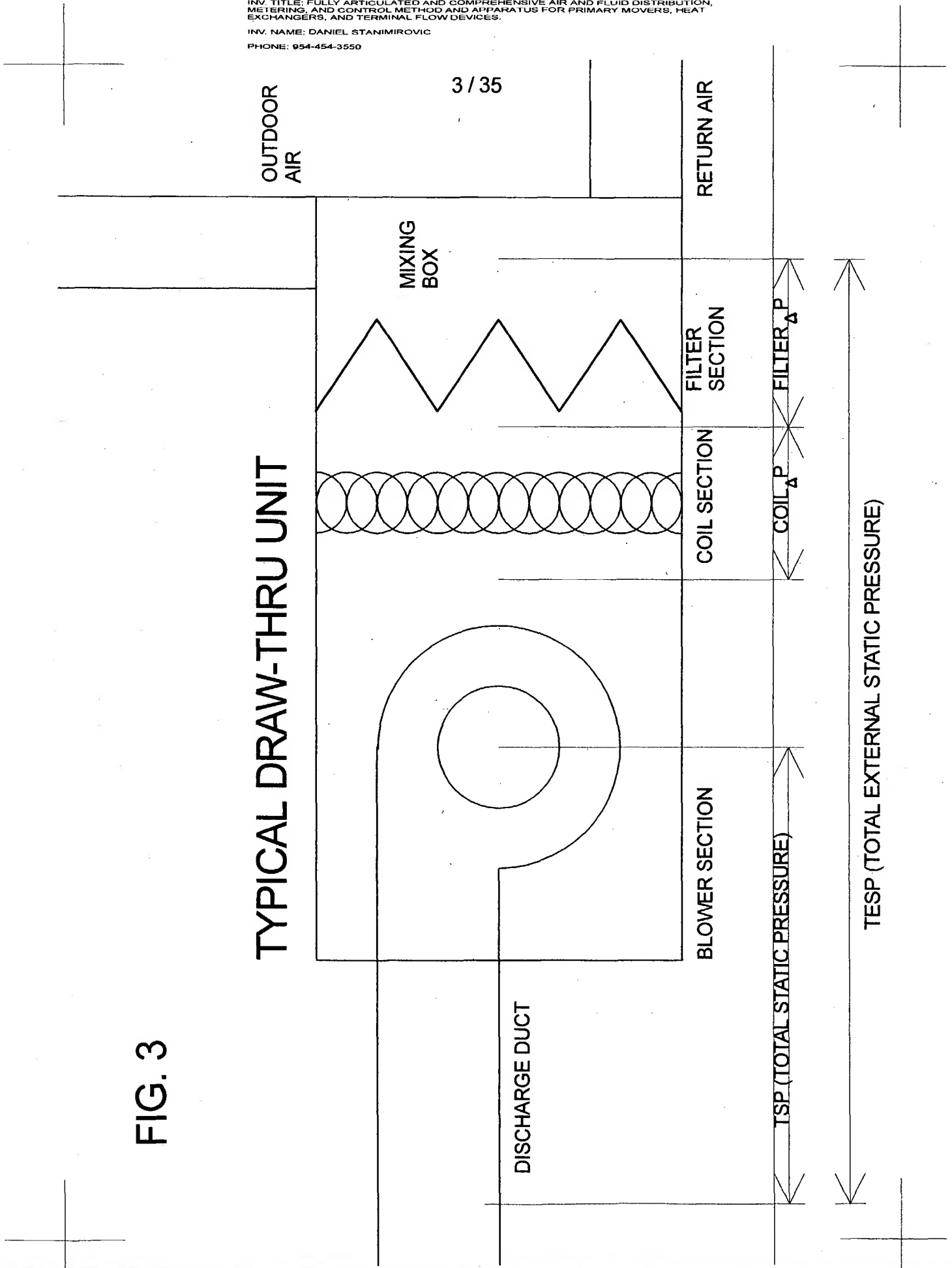
DISCHARGE DUCT

FILTER  $\Delta P$

COIL  $\Delta P$

TSP (TOTAL STATIC PRESSURE)

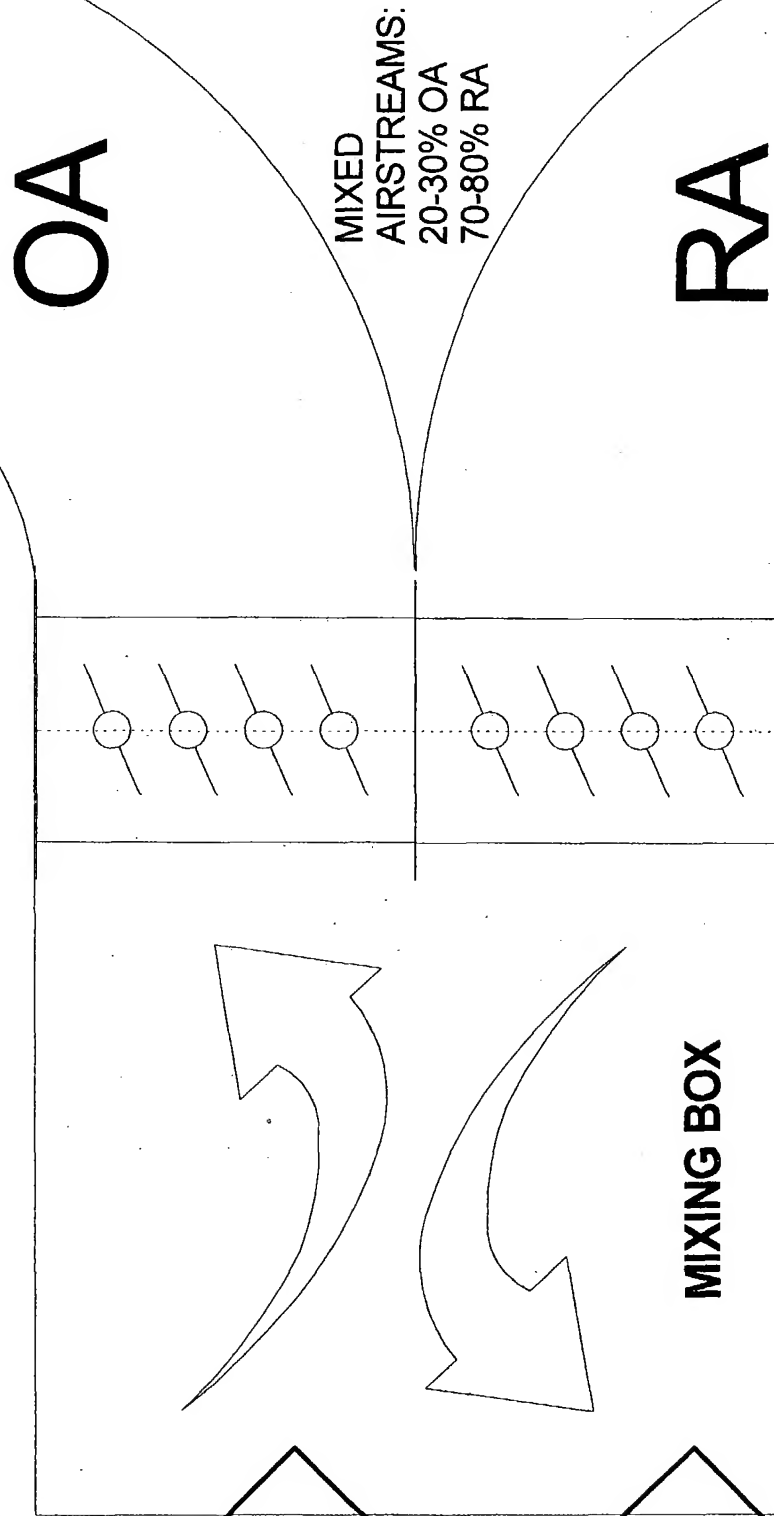
TESP (TOTAL EXTERNAL STATIC PRESSURE)



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FIG. 4

**NORMAL MODE OPERATION**



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FIG. 4A

SMOKE MODE OPERATION

OA

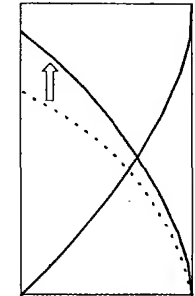
AIRSTREAM:  
100% OA

RA

RA DAMPER FULLY CLOSED

100% OA

MIXING BOX



SP Vp TP  
TOTAL SYS. CURVE  
AND OP IS ALTERED  
BY CHANGE OF MODE,  
DAMPER POSITIONS

# TRADITIONAL FAN PERFORMANCE CURVES

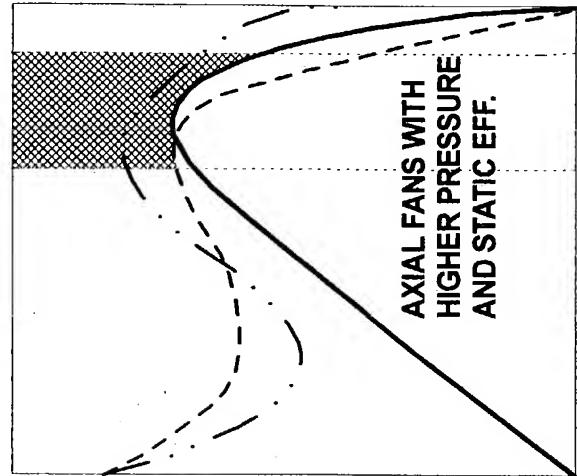
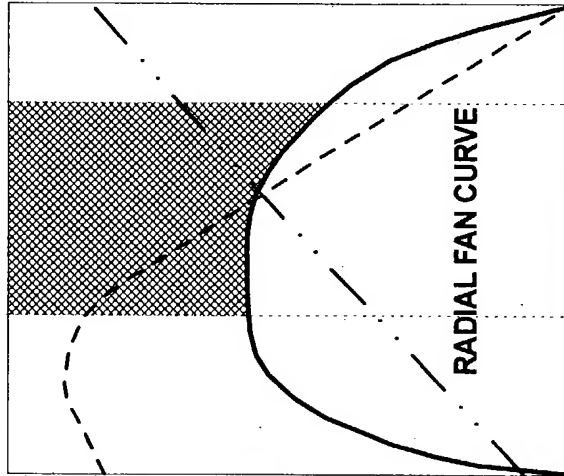
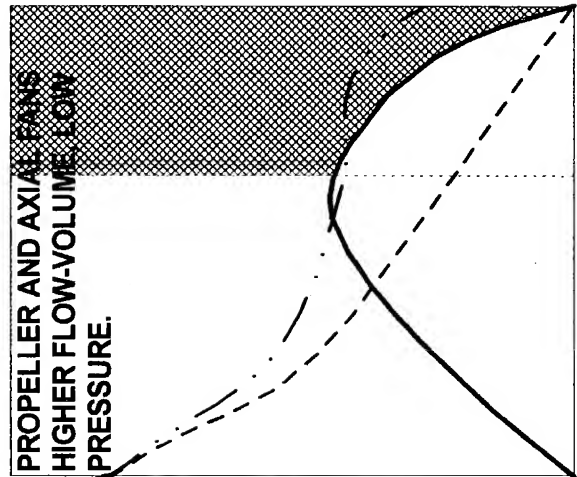
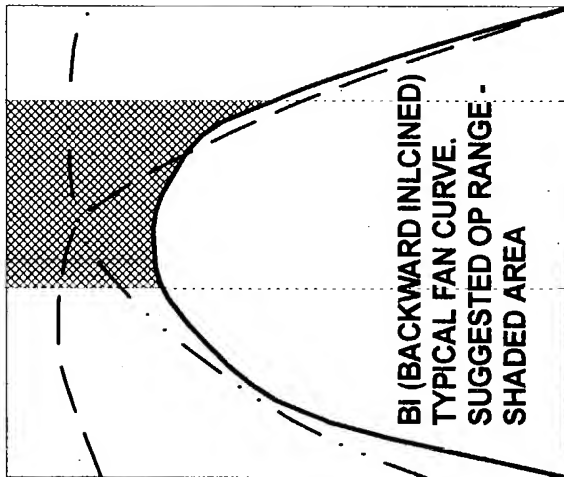
FIG. 5

SP \_\_\_\_\_  
 STATIC EFF. \_\_\_\_\_  
 BHP \_\_\_\_\_

SP CURVE OCCURS AT  
 SPECIFIED FRPM AND IS THE  
 BASIS FOR DETERMINING OP  
 WHEN PLOTTED AGAINST  
 A GIVEN SYSTEM.

NEW METHOD SHALL FURTHER  
 BREAK DOWN THIS CURVE INTO  
 THE THREE KEY COMPONENTS  
 FOR ANALYSIS: SP,  $V_p$ , TP

THIS WILL ALSO PROVIDE  
 THE BEST MEANS OF PAIRING A  
 PRIME MOVER AND ITS  
 SYSTEM FOR EQUIPMENT  
 SELECTION.



INV. TITLE: FULLY ARTICULATED AND COMPREHENSIVE AIR AND FLUID DISTRIBUTION,  
METERING, AND CONTROL METHOD AND APPARATUS FOR PRIMARY MOVERS, HEAT  
EXCHANGERS, AND TERMINAL FLOW DEVICES.

INV. NAME: DANIEL STANIMIROVIC

PHONE: 954-454-3550

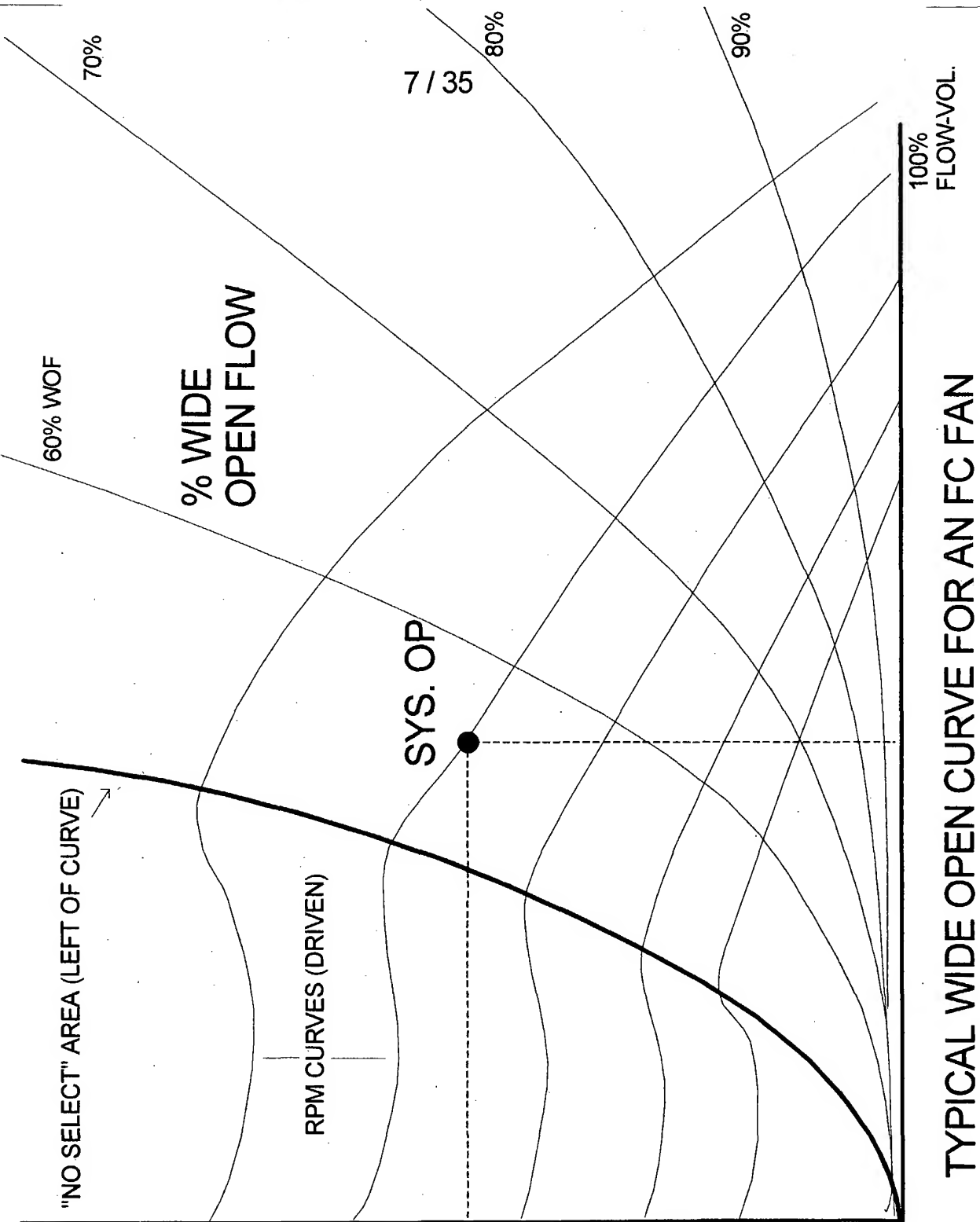
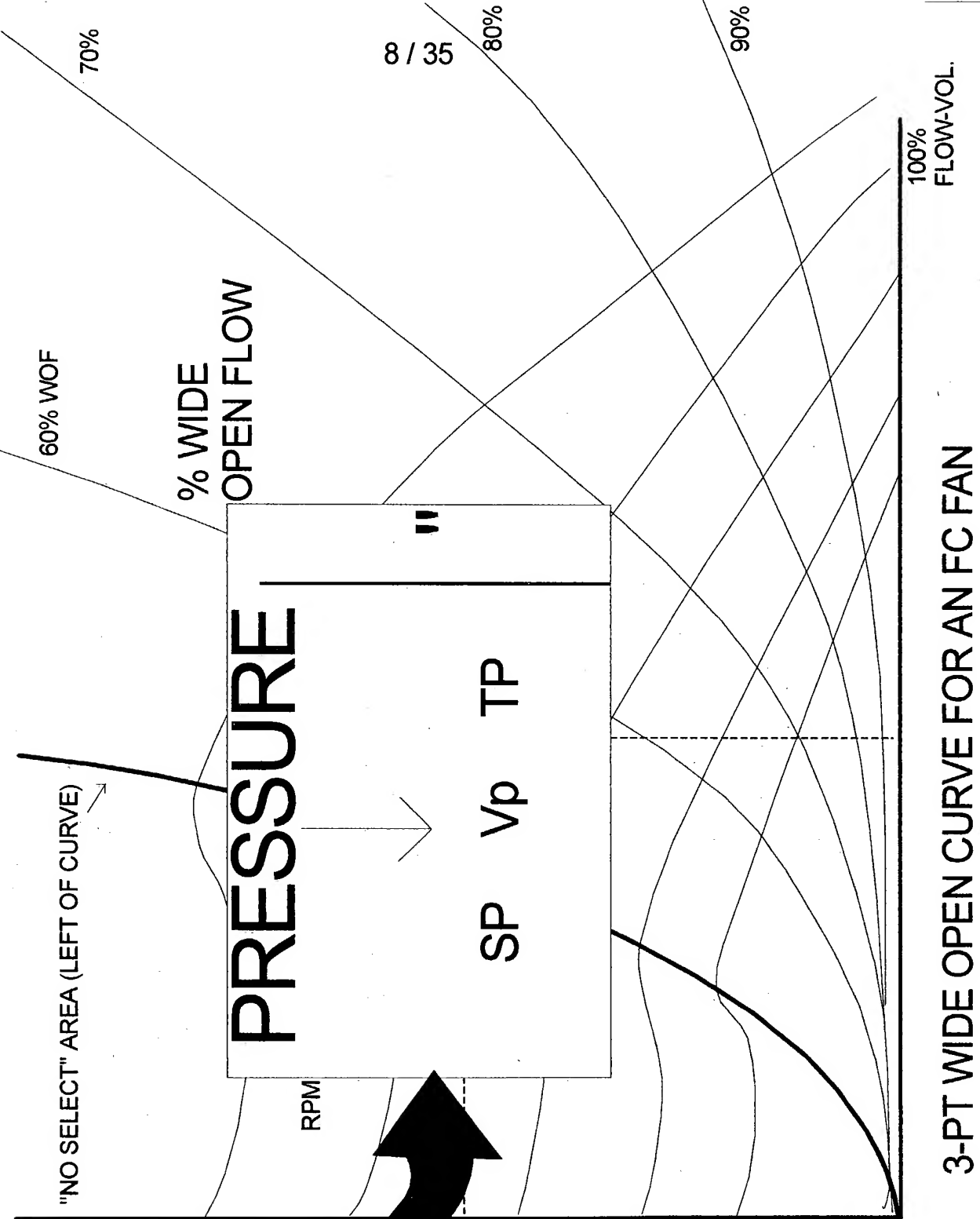


FIG. 6

INV. TITLE: FULLY ARTICULATED AND COMPREHENSIVE AIR AND FLUID DISTRIBUTION,  
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EXCHANGERS, AND TERMINAL FLOW DEVICES.

INV. NAME: DANIEL STANIMIROVIC

PHONE: 854-454-3550

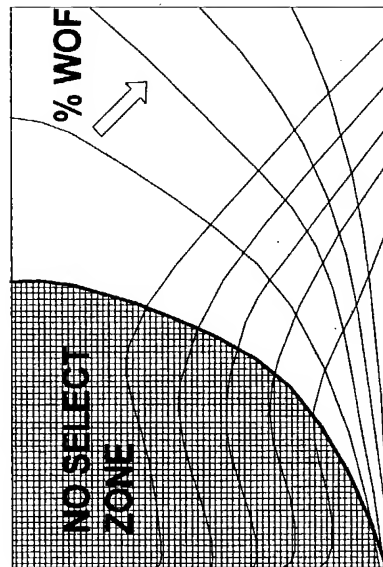




# WIDE OPEN AND SYSTEM CURVES JUXTAPOSED

FIG. 7

KNOWN PRIME MOVER WOC



100%  
FLOW-VOL.

UNKNOWN TOTAL SYSTEM ATTACHED

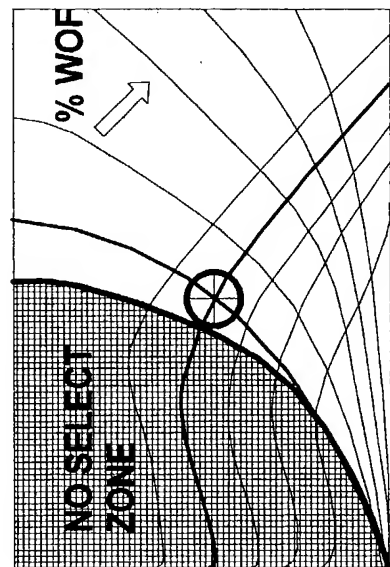
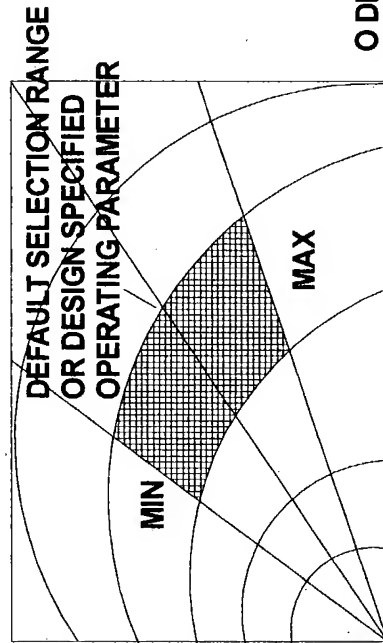


FIG. 7A

TERMINAL OR IN-LINE DEVICE WOC

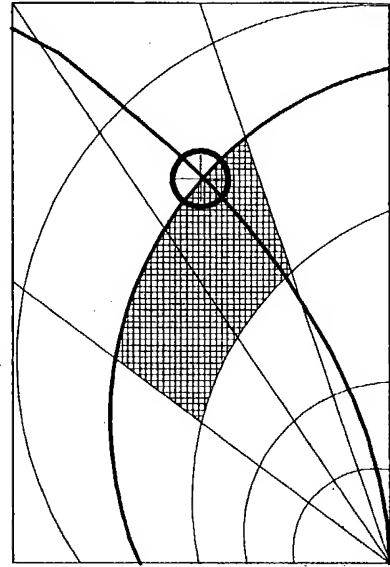


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0 DEGREES OR  
100% OPEN

UNKNOWN SUB-SYSTEM ATTACHED



# PRIMARY OR TERMINAL HEAT EXCHANGE

FIG. 8

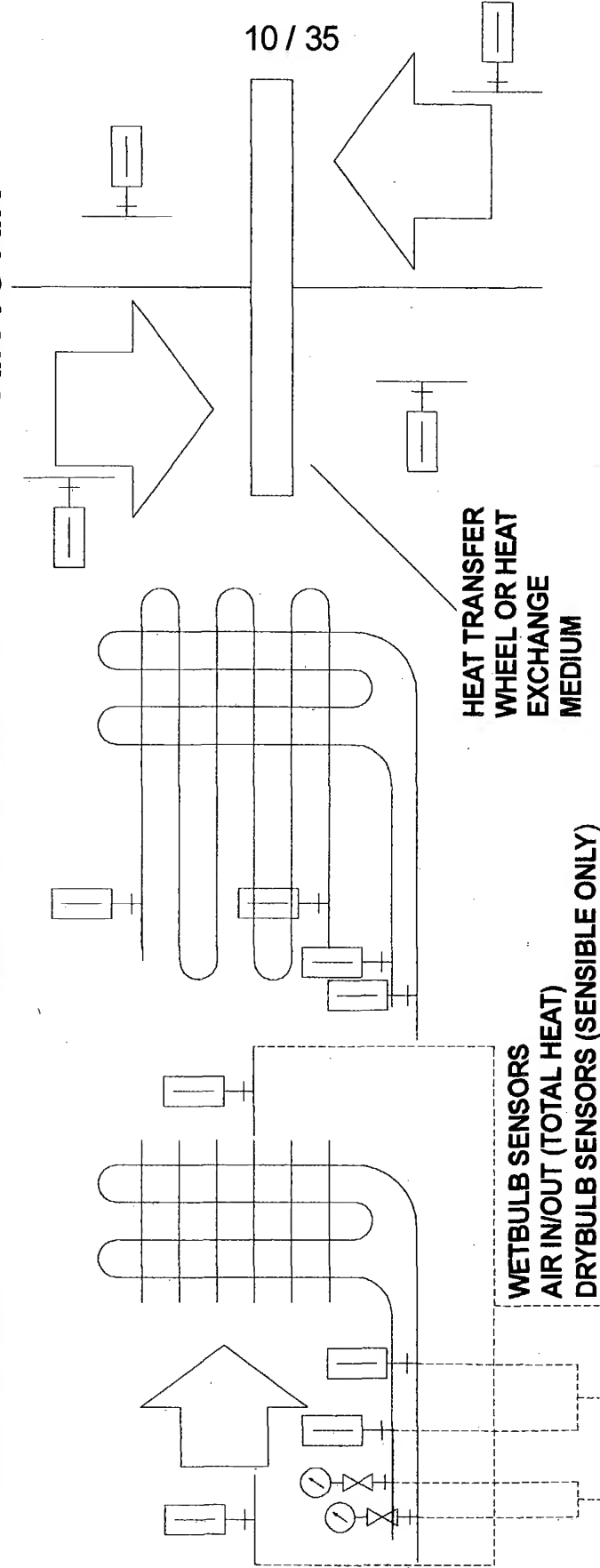
AIR TO WATER

FIG. 8A

WATER TO WATER

FIG. 8B

AIR TO AIR

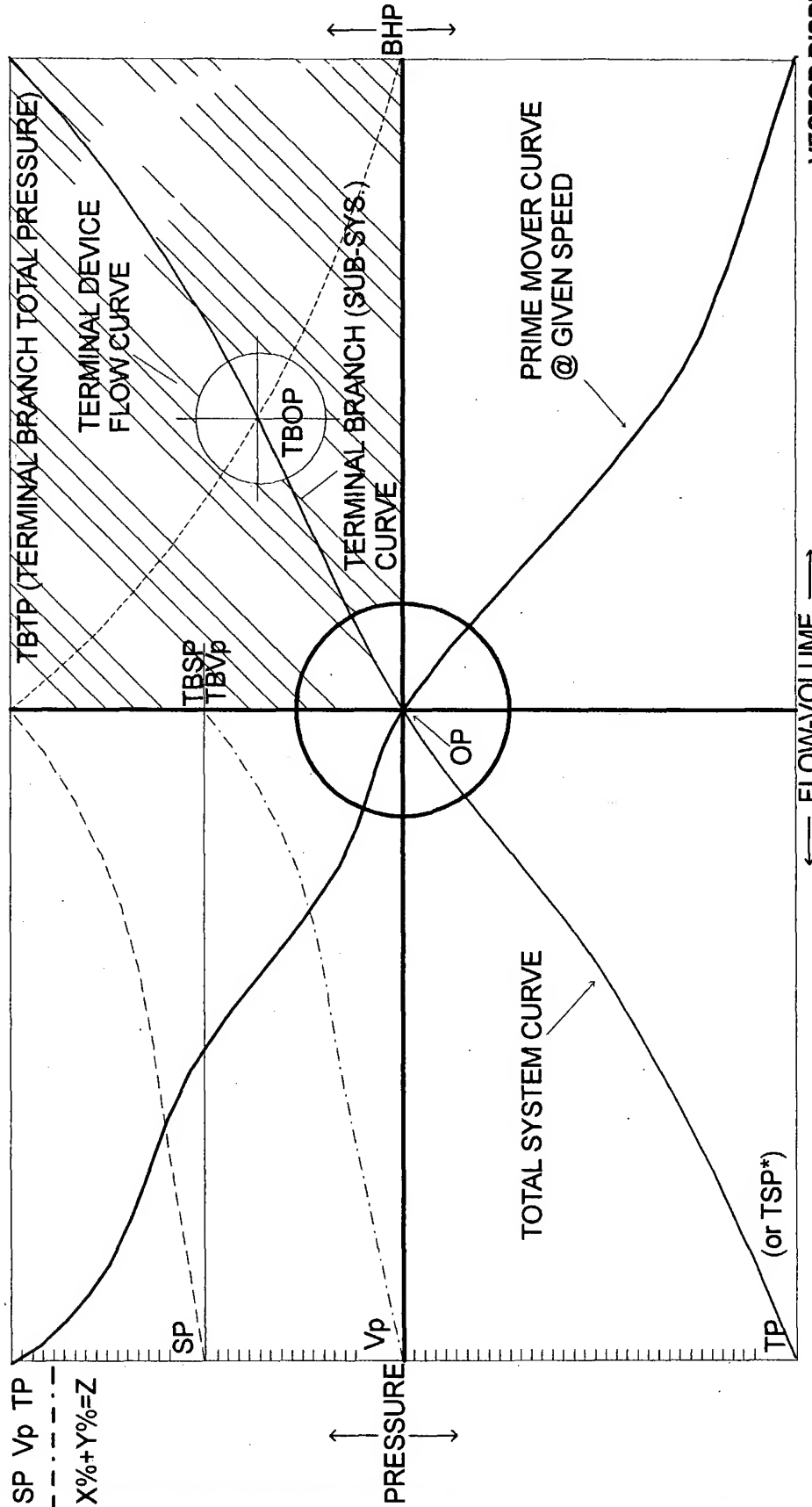


AIR-GAS-FLUIDS TO SAME  
FLUIDS TO FLUIDS  
GASES TO GASES  
FLUIDS TO GASES, VICE VERSA  
MIXTURES TO MIXTURES  
(ALL OF THE ABOVE)

\*VARIATIONS WOULD INCLUDE THE FOLLOWING IN ANY ARRANGEMENT, FORM, NUMBER, OR COMBINATION:

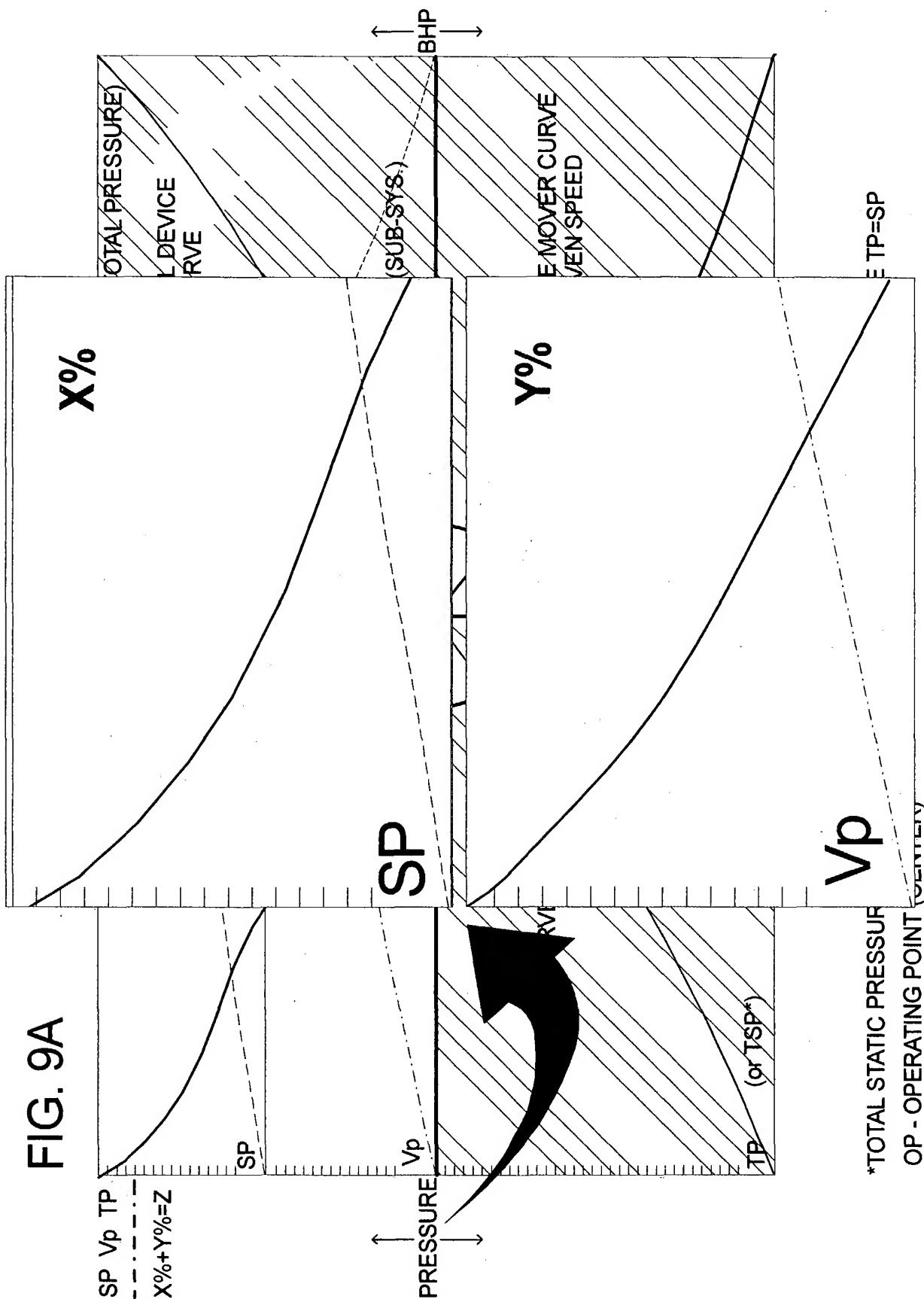
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FIG. 9 MAIN PANEL DISPLAY



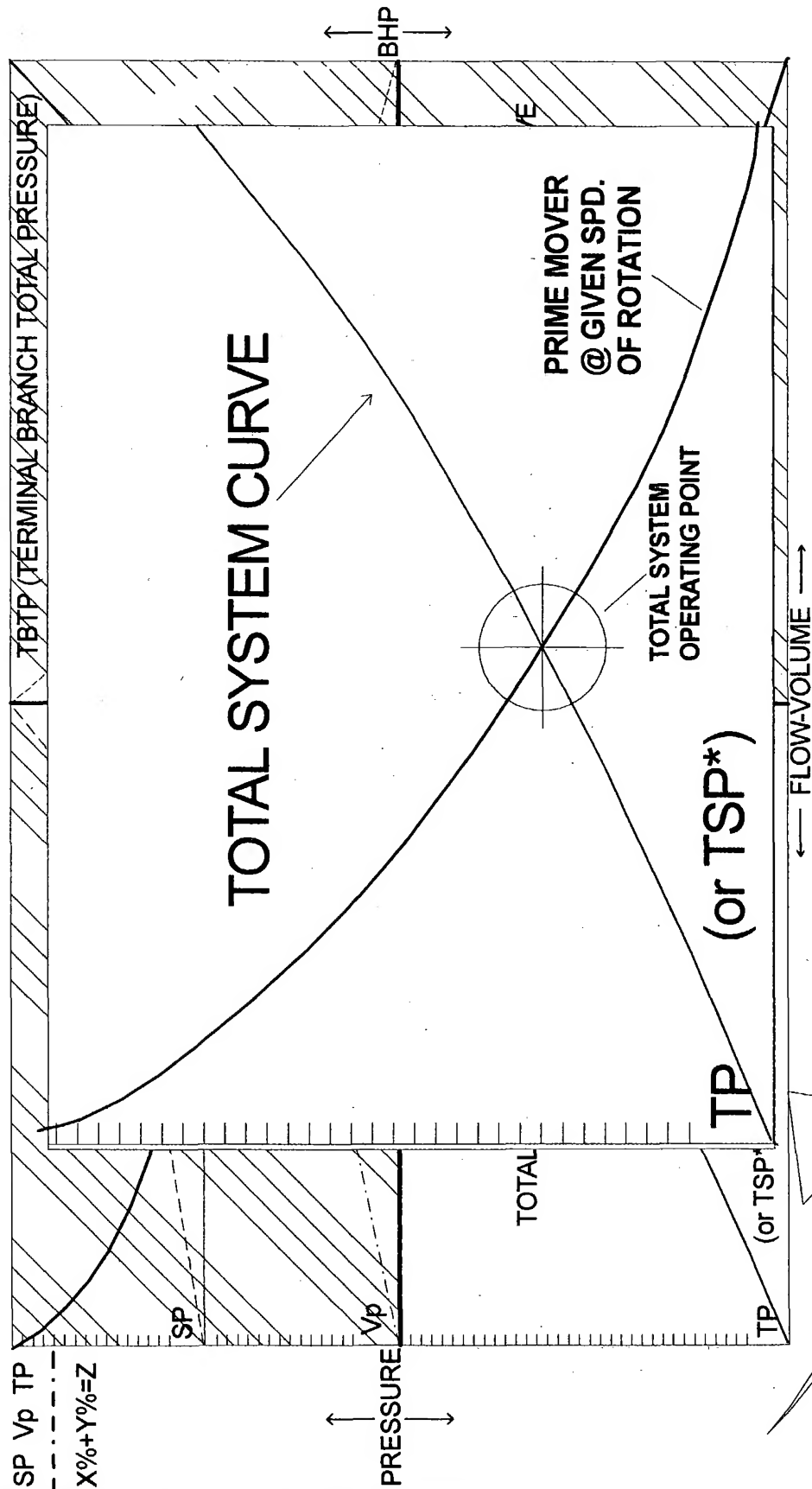
\*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP  
OP - OPERATING POINT (CENTER)

FIG. 9A



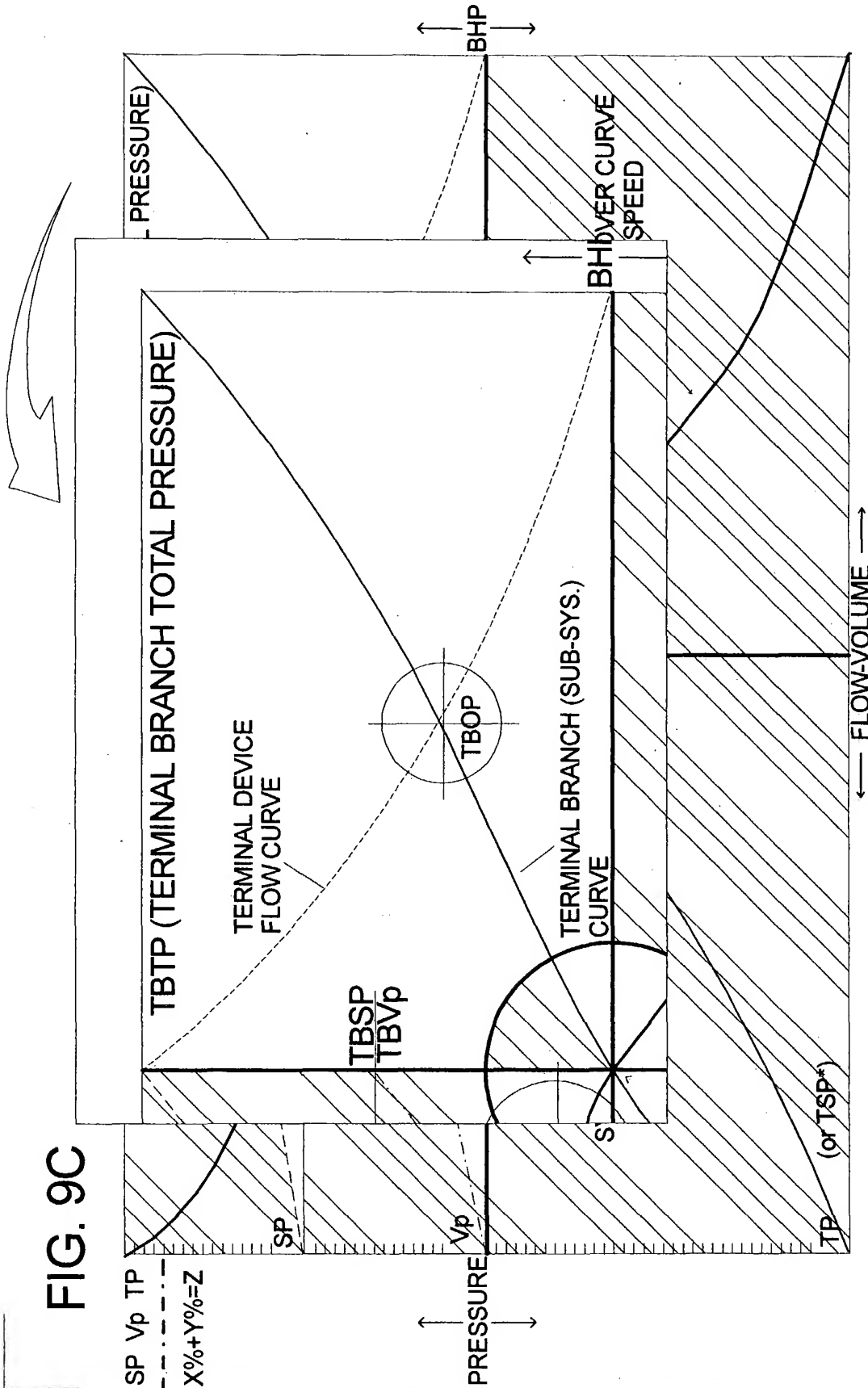
\*TOTAL STATIC PRESSURE  
OP - OPERATING POINT

**FIG. 9B**



\*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP  
OP - OPERATING POINT (CENTER)

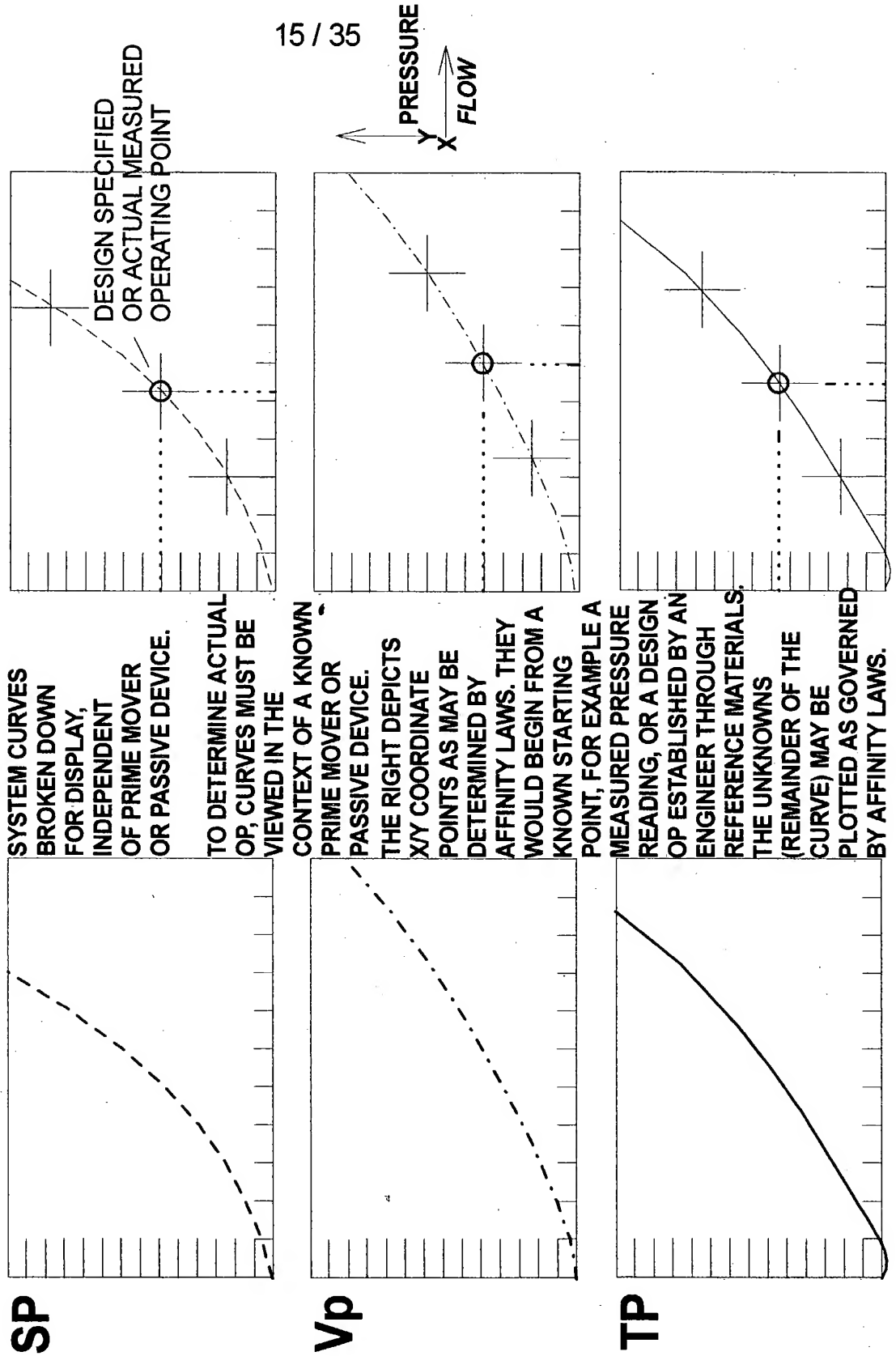
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\*TOTAL STATIC PRESSURE AS WITH TRADITIONAL PERFORMANCE CURVES, WHERE TP=SP  
OP - OPERATING POINT (CENTER)

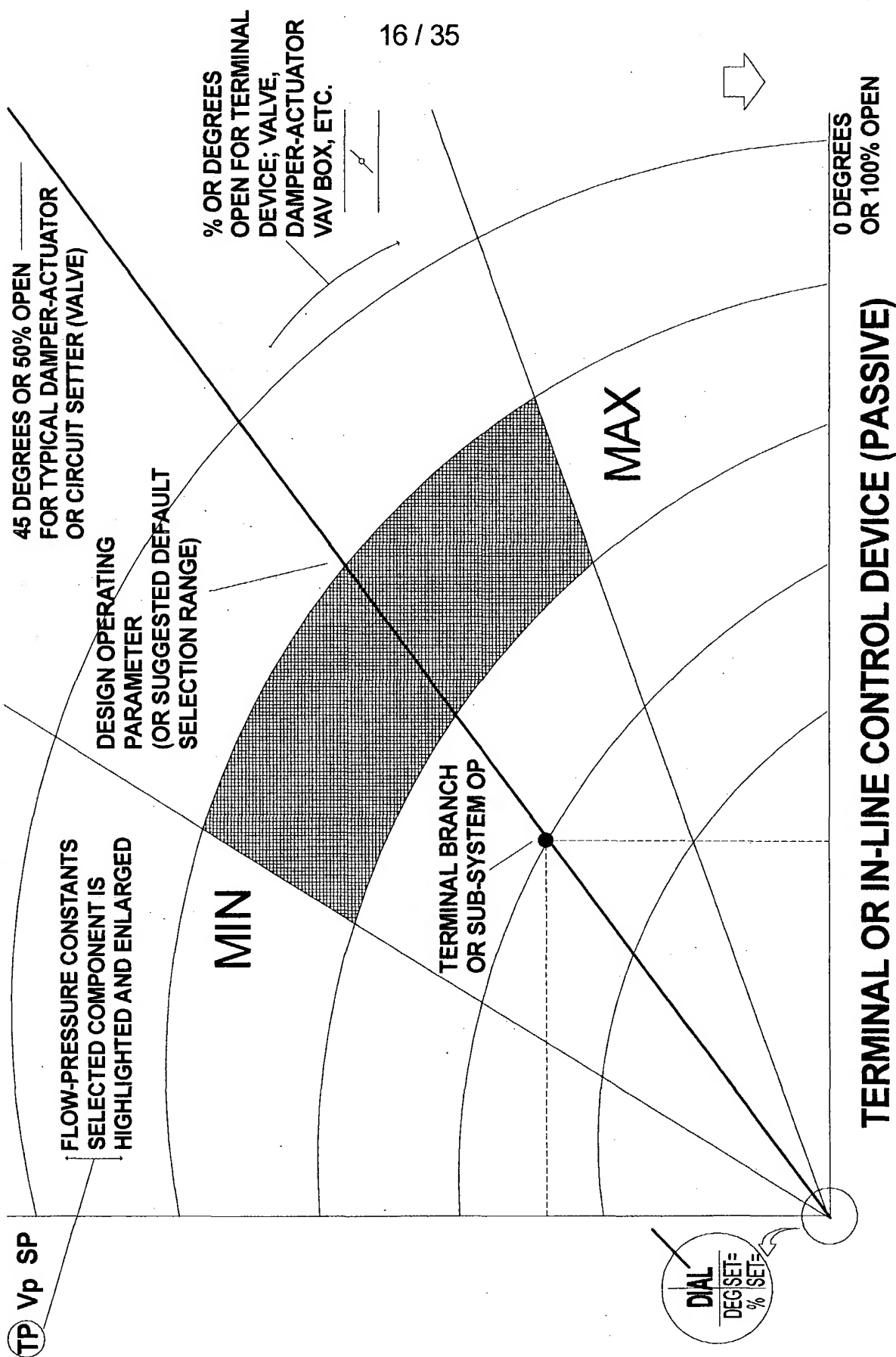
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FIG. 10 3-PART SYSTEM CURVES VIEWED INDEPENDENTLY



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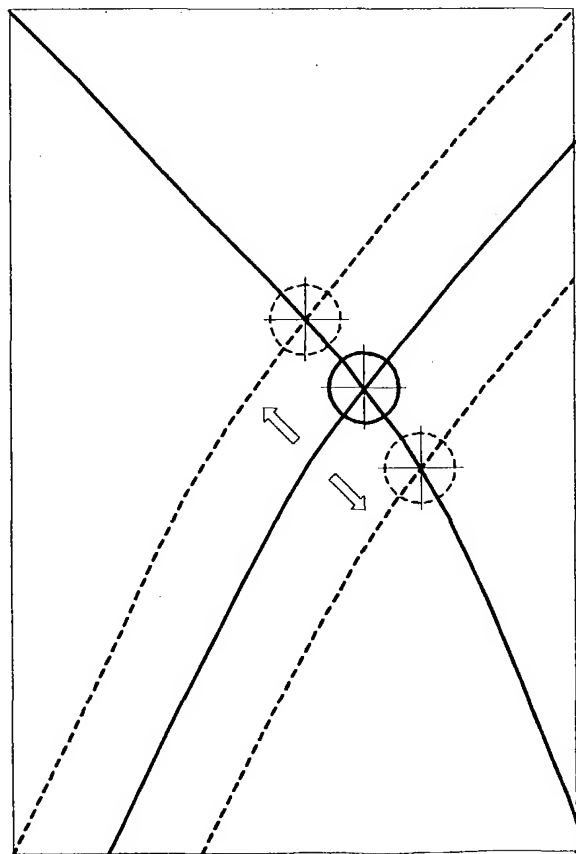
# FIG. 11 TERMINAL DEVICE (WOC) WIDE OPEN CURVE





# CURVE RIDING AND OP DEVIATION

FIG. 12



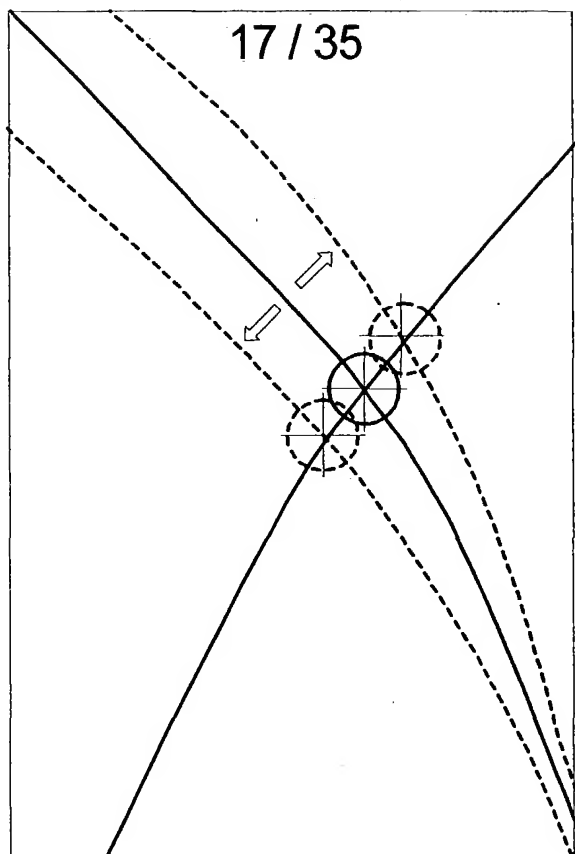
**PRIME MOVER CHANGES**

ROTATIONAL SPEED

SECONDARY MOVER

SERIES OR PARALLEL  
OPERATION

FIG. 12A



**SYSTEM CHANGES**

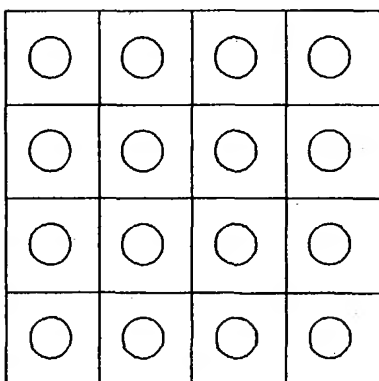
**TP SP Vp**

FIG. 13

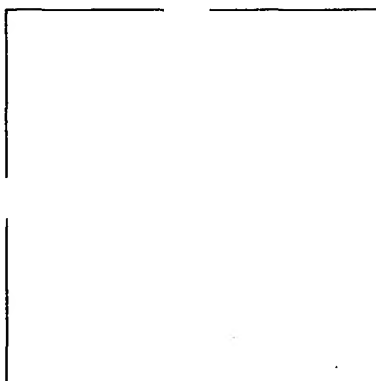
SENSOR LOGIC



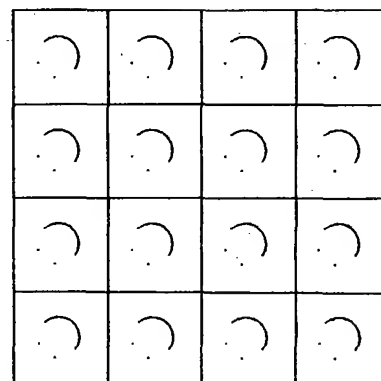
DUCT CROSS-SECTIONAL EQUAL AREA TRAVERSE



TOTAL IMPACT SENSORS



STATIC ONLY SENSORS



VELOCITY ONLY SENSORS  
TP-SP, AS WITH PITOT TUBE

# PRIME MOVER SENSOR LOGIC

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FIG. 14

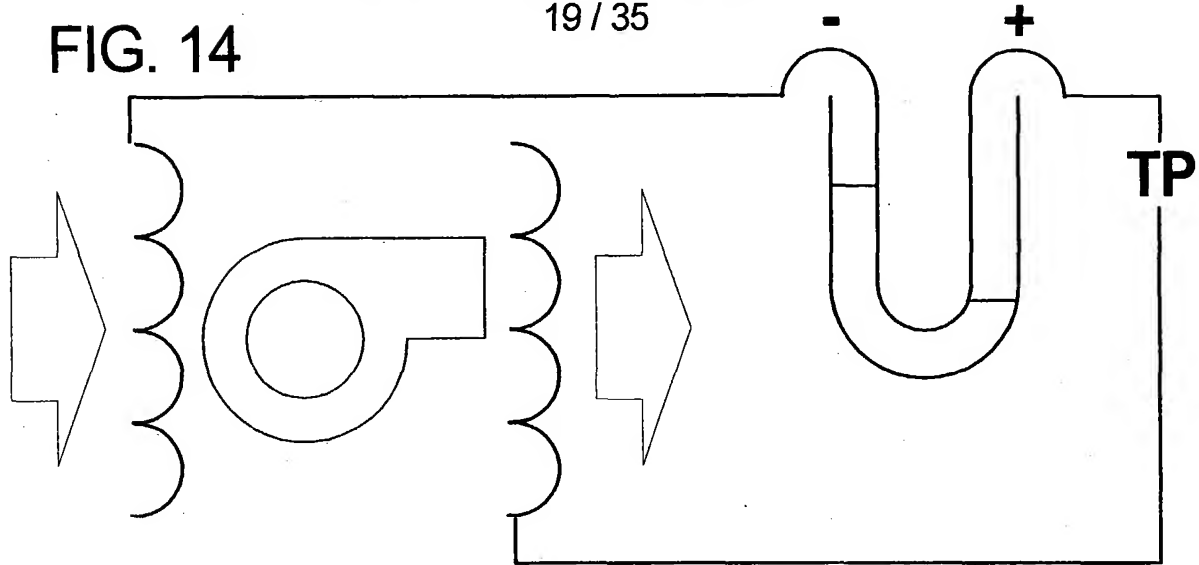


FIG. 14A

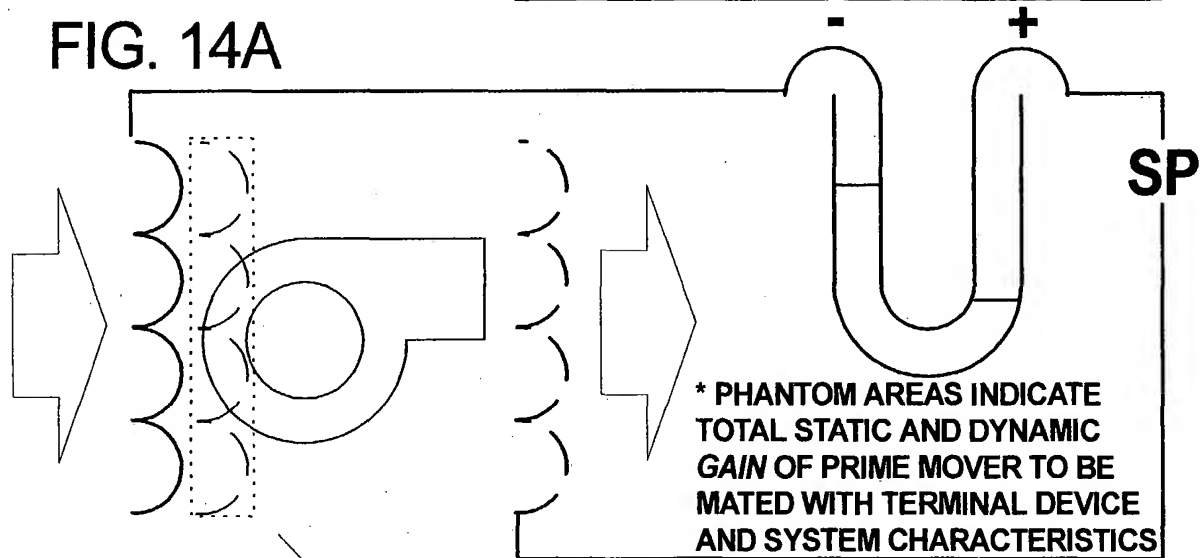
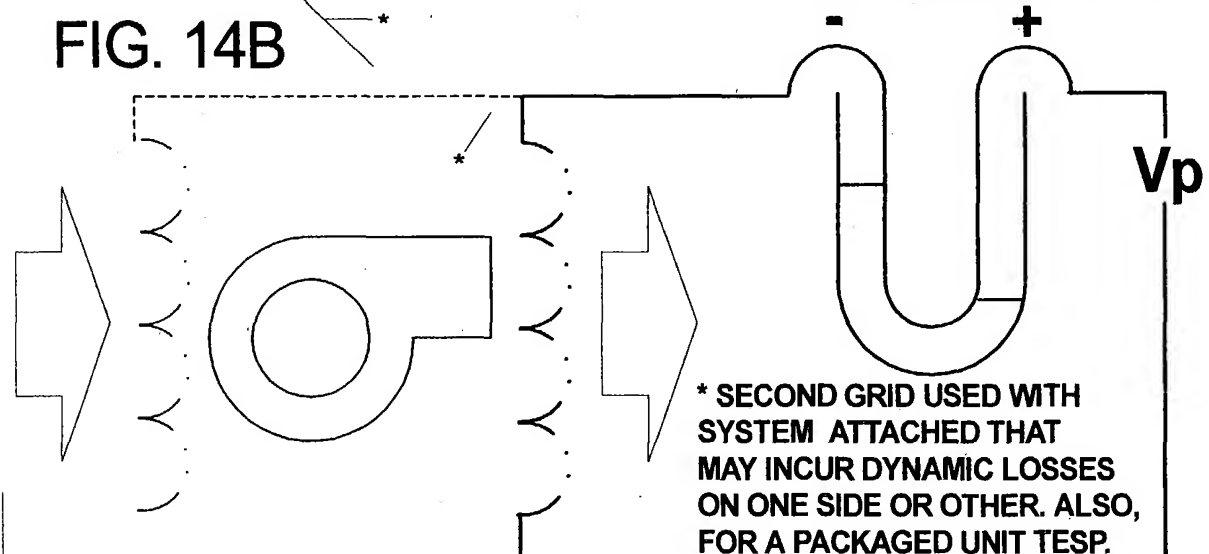


FIG. 14B

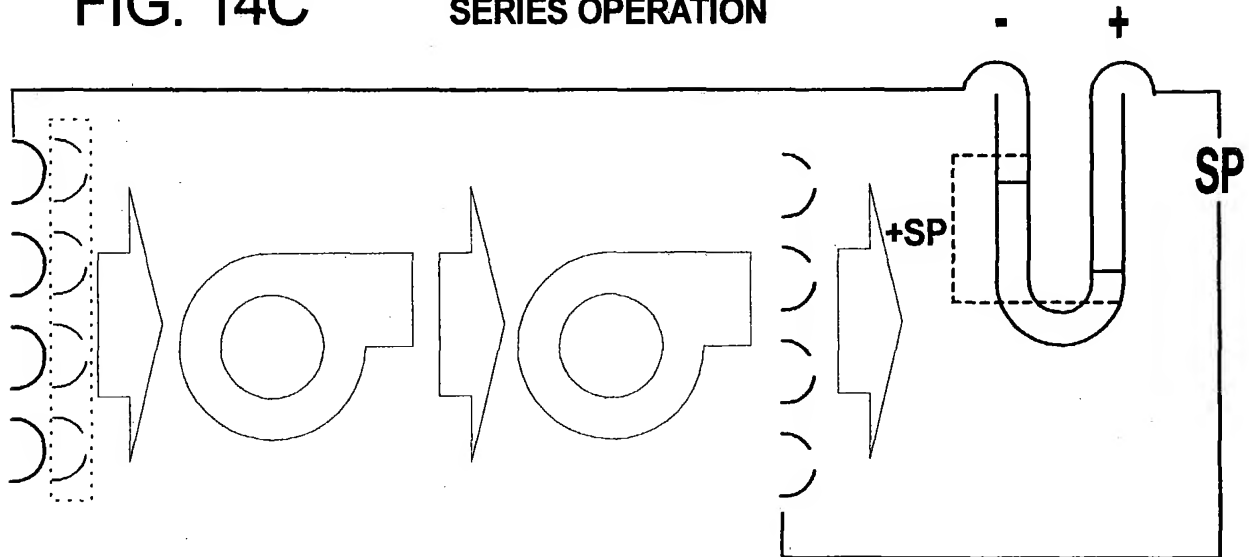


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## MOVER SENSOR LOGIC IN SERIES OR PARALLEL OPERATION

FIG. 14C

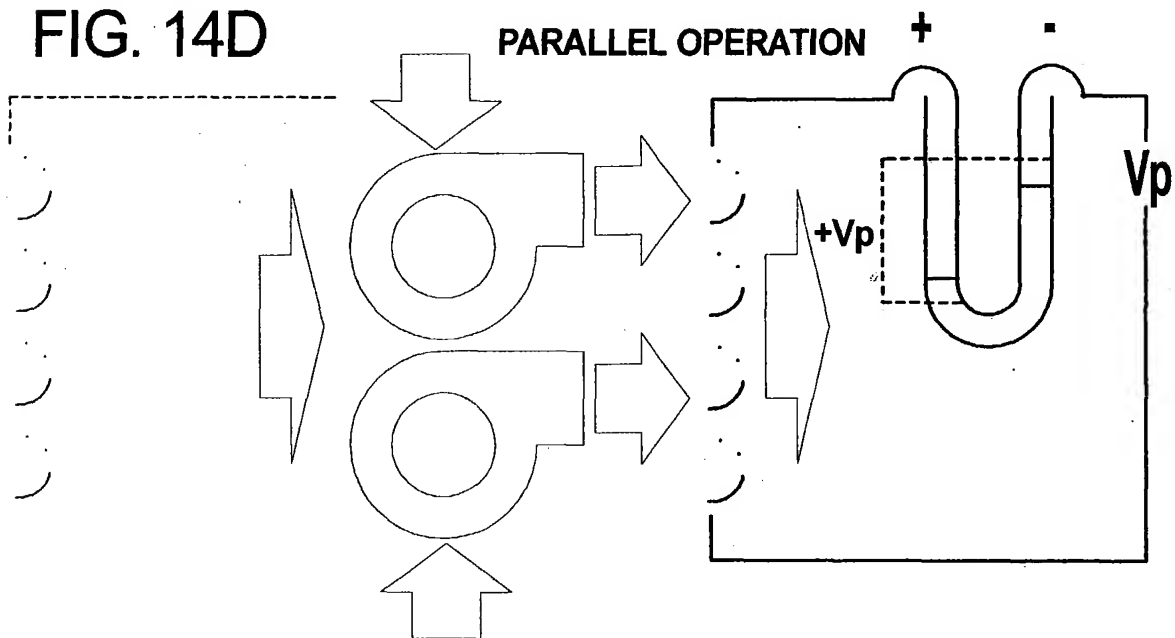
SERIES OPERATION



ONE OR MORE PRIMARY MOVERS IN SERIES OR PARALLEL  
AUGMENT EITHER SP OR  $V_p$ , RESPECTIVELY, AS SHOWN.

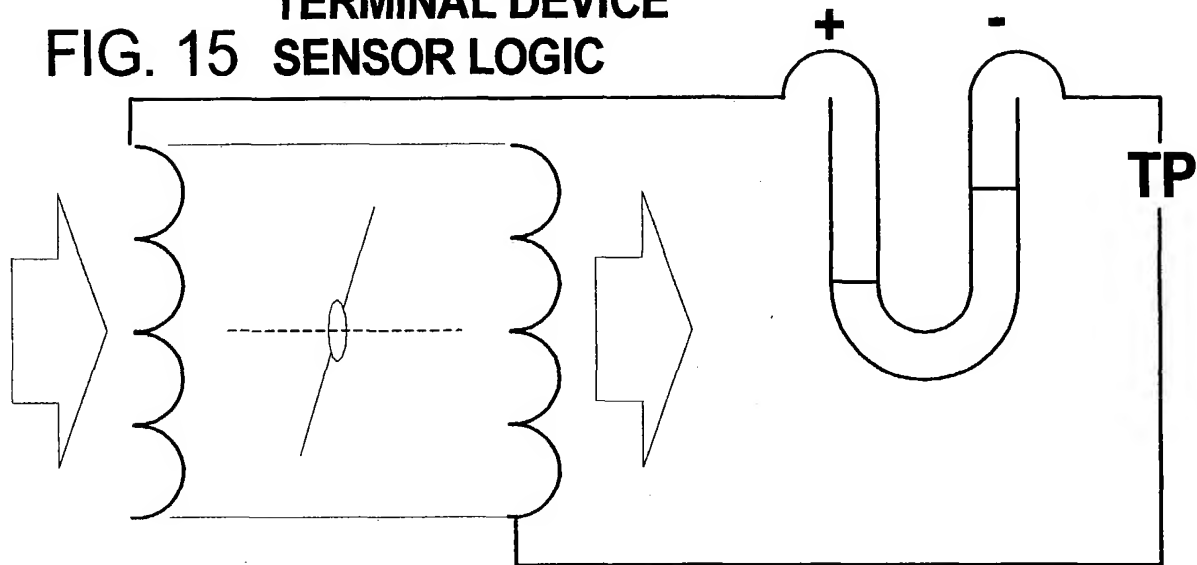
FIG. 14D

PARALLEL OPERATION

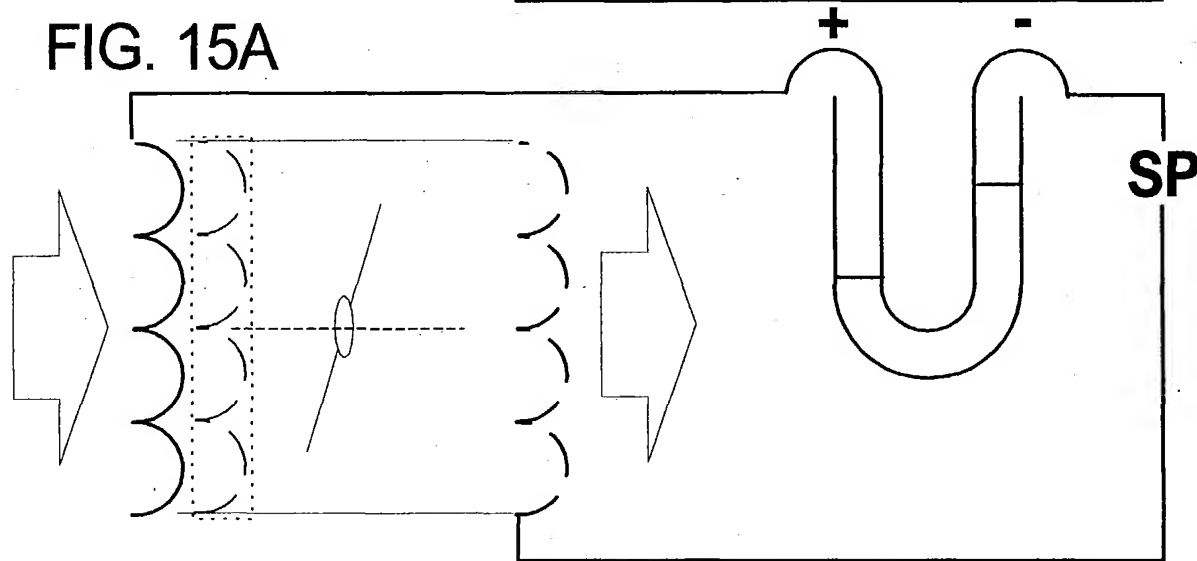


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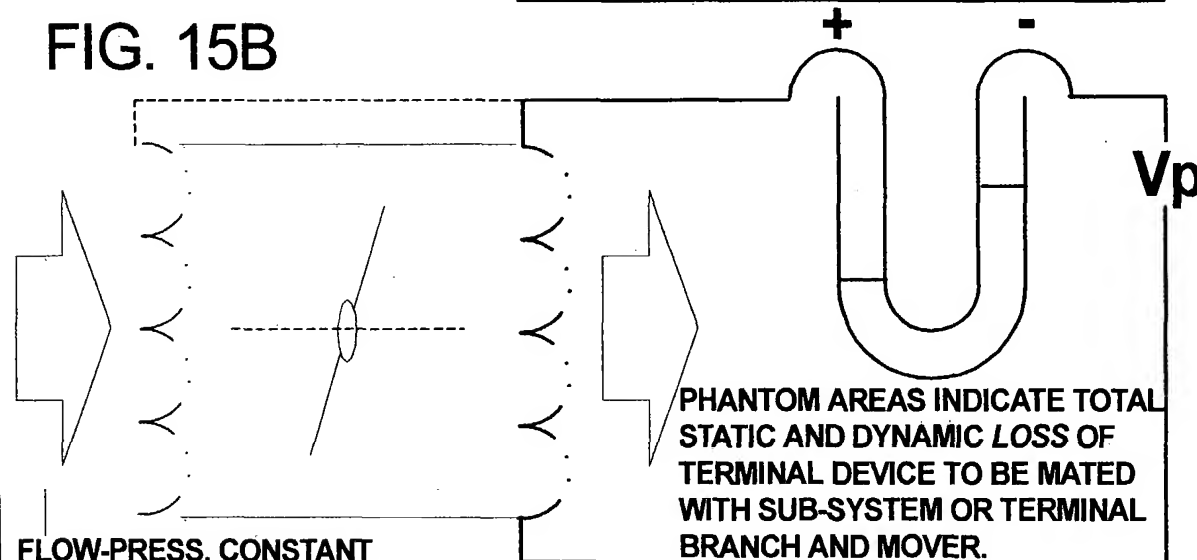
# **FIG. 15** **SENSOR LOGIC**



**FIG. 15A**



**FIG. 15B**



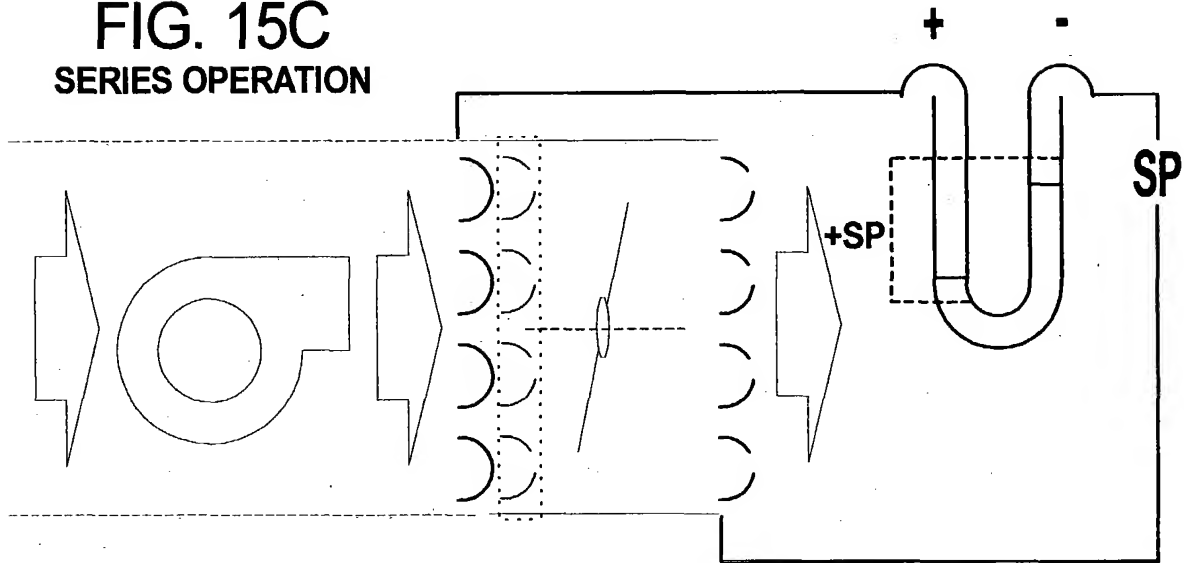
FLOW-PRESS. CONSTANT

PHANTOM AREAS INDICATE TOTAL  
STATIC AND DYNAMIC LOSS OF  
TERMINAL DEVICE TO BE MATED  
WITH SUB-SYSTEM OR TERMINAL  
BRANCH AND MOVER.

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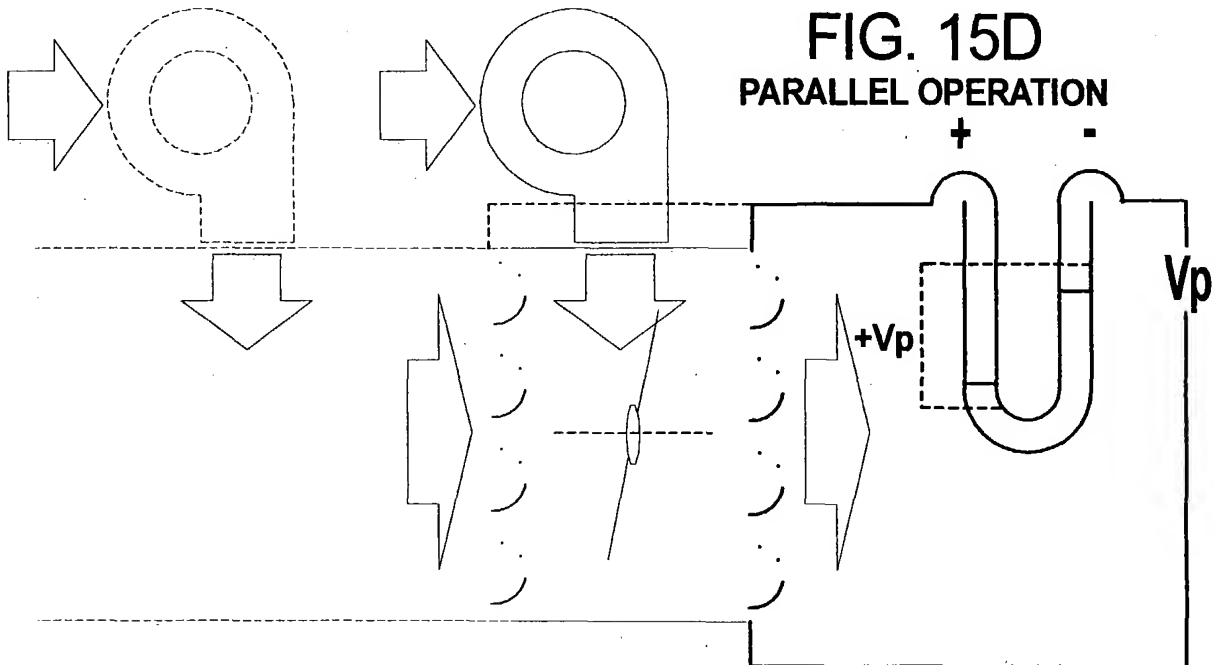
## TERMINAL DEVICE SENSOR LOGIC WITH SECONDARY MOVER

**FIG. 15C**  
**SERIES OPERATION**



ONE OR MORE SECONDARY MOVERS IN SERIES OR PARALLEL  
AUGMENT EITHER SP OR  $V_p$ , RESPECTIVELY, AS SHOWN.

**FIG. 15D**  
**PARALLEL OPERATION**



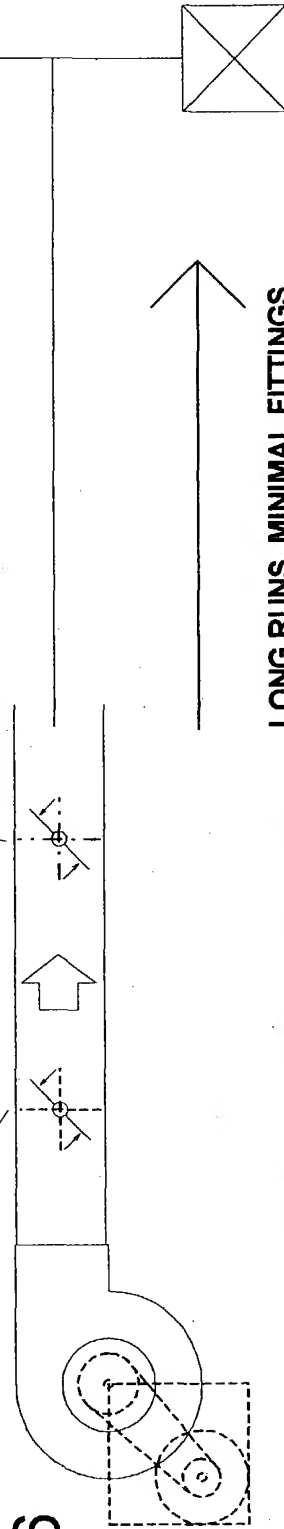
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## DUAL DAMPER CONTROL IN SERIES AND PARALLEL

PRIMARY DAMPER CONTROLS STATIC PRESSURE AND TOTAL PRESSURE FROM PRIME MOVER IN TANDEM WITH MOTOR/DRIVE SPEED CONTROL.

SECONDARY DAMPER CONTROLS FLOW RATE DOWNSTREAM AFTER DESIRED TOTAL POWER IS ADJUSTED.

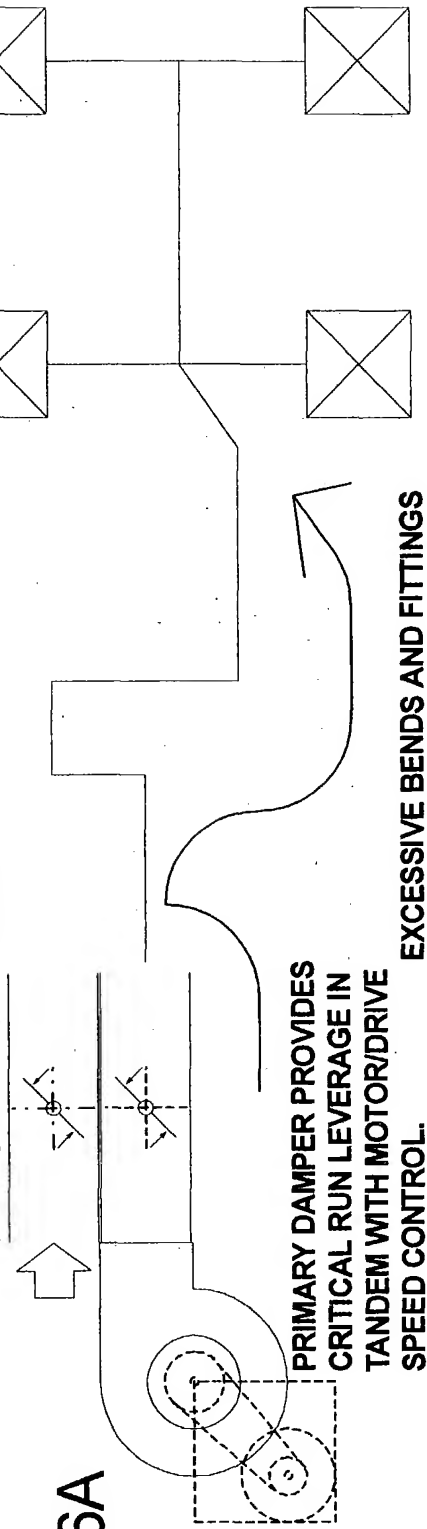
FIG. 16



LONG RUNS, MINIMAL FITTINGS

PARALLEL DAMPER AND FLOW SOURCE PROVIDES CUMULATIVE VELOCITY TO TRAVERSE FITTING AND DIRECTIONAL LOSSES

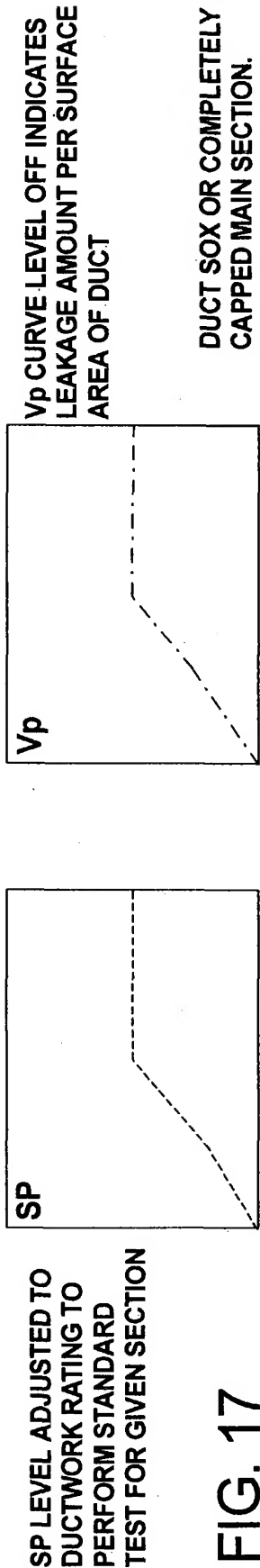
FIG. 16A



PRIMARY DAMPER PROVIDES CRITICAL RUN LEVERAGE IN TANDEM WITH MOTOR/DRIVE SPEED CONTROL.

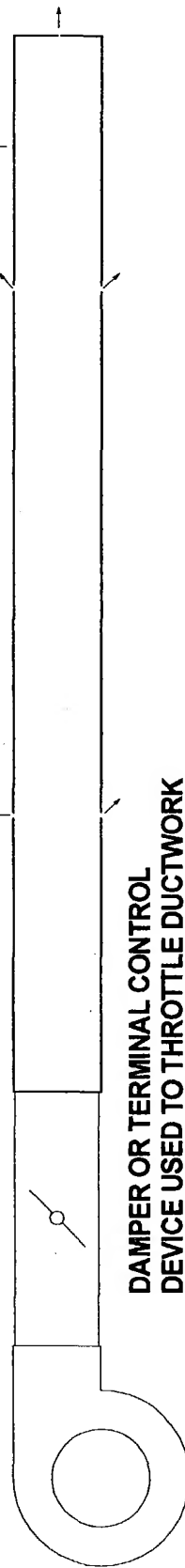
EXCESSIVE BENDS AND FITTINGS

## LEAKAGE TESTER



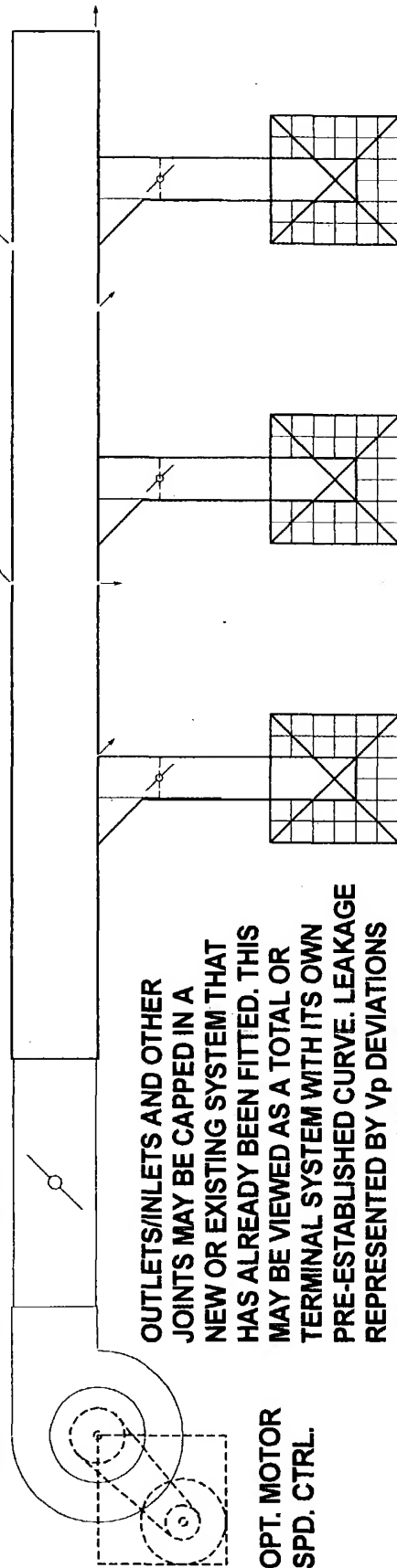
DUCT SOX OR COMPLETELY CAPPED MAIN SECTION.

FIG. 17



DAMPER OR TERMINAL CONTROL DEVICE USED TO THROTTLE DUCTWORK TO ITS GIVEN PRESSURE RATING AND MAINTAIN THIS LEVEL

FIG. 17A



OUTLETS/INLETS AND OTHER JOINTS MAY BE CAPPED IN A NEW OR EXISTING SYSTEM THAT HAS ALREADY BEEN FITTED. THIS MAY BE VIEWED AS A TOTAL OR TERMINAL SYSTEM WITH ITS OWN PRE-ESTABLISHED CURVE. LEAKAGE REPRESENTED BY Vp DEVIATIONS (INCREASES) FROM A FIRMLY ESTABLISHED OPERATING POINT. SEE FIG. 12, 12A, OP DEVIATION.

OPT. MOTOR SPD. CTRL.

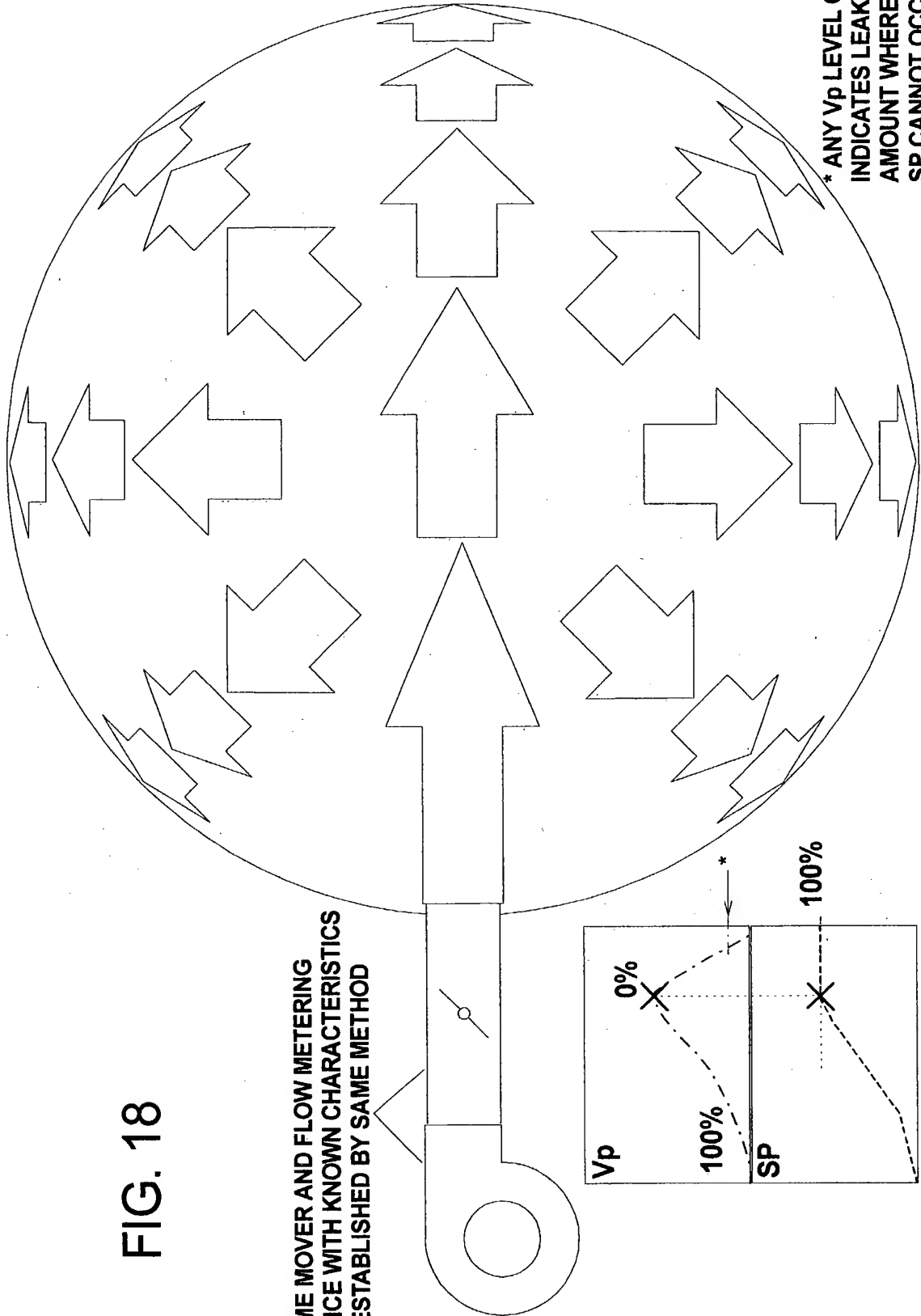


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# VOLUME OF A GIVEN VESSEL OR ENCLOSURE

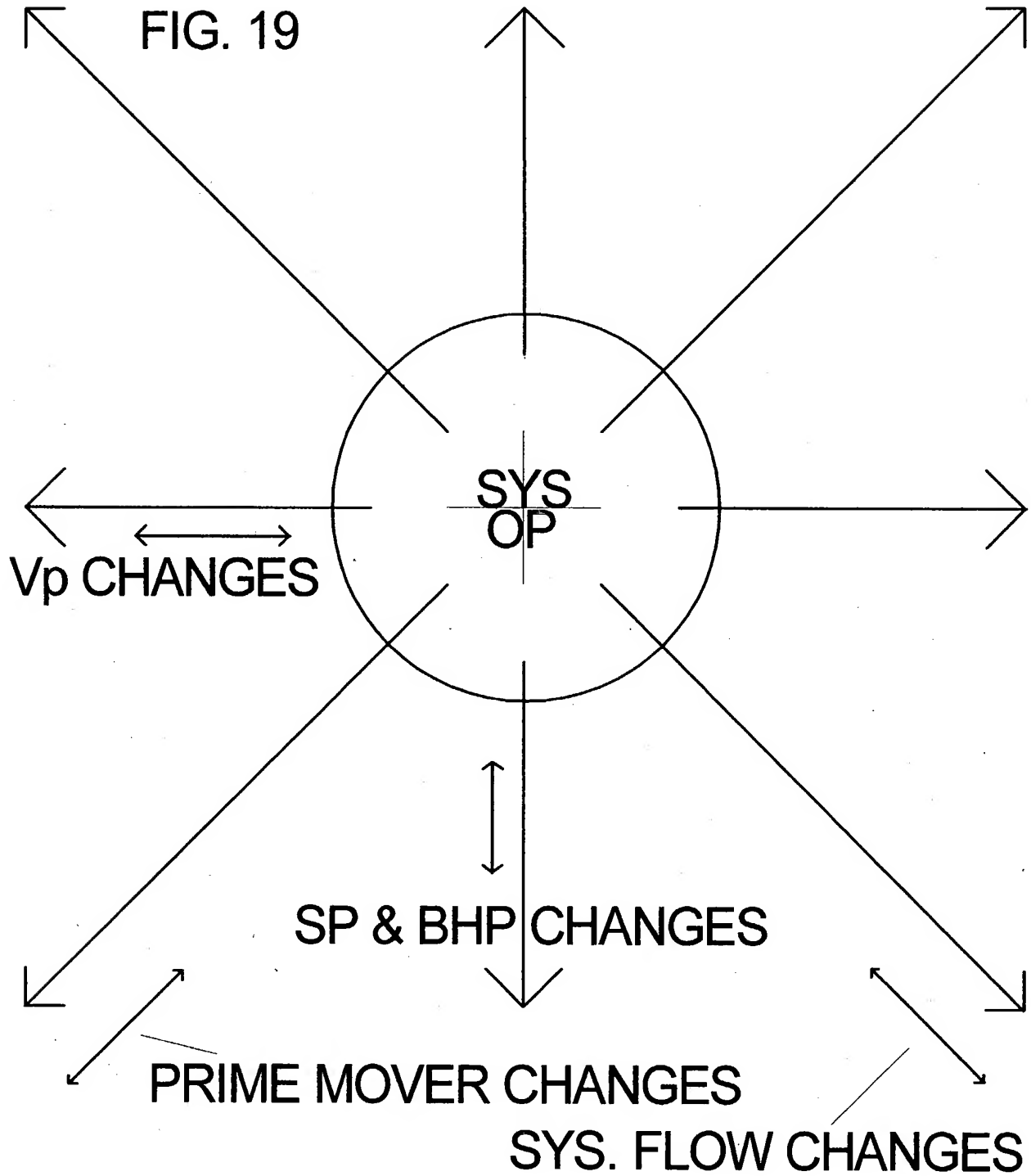
FIG. 18

PRIME MOVER AND FLOW METERING  
DEVICE WITH KNOWN CHARACTERISTICS  
AS ESTABLISHED BY SAME METHOD



\* ANY Vp LEVEL OFF  
INDICATES LEAKAGE  
AMOUNT WHERE 100%  
SP CANNOT OCCUR

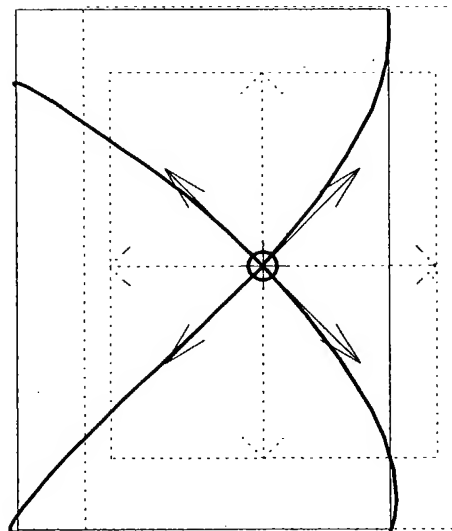
## VECTORIAL DISPLAY



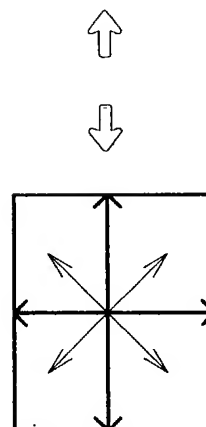
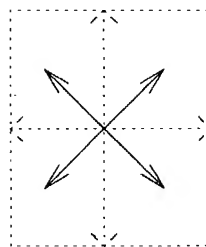
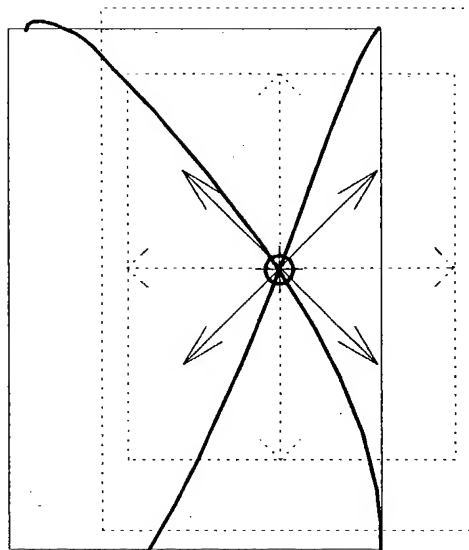
# VECTORIAL ANALYSIS - TOTAL SYSTEM TO SUB-SYSTEM

FIG. 19A

TOTAL SYSTEM OP



TERMINAL BRANCH OP

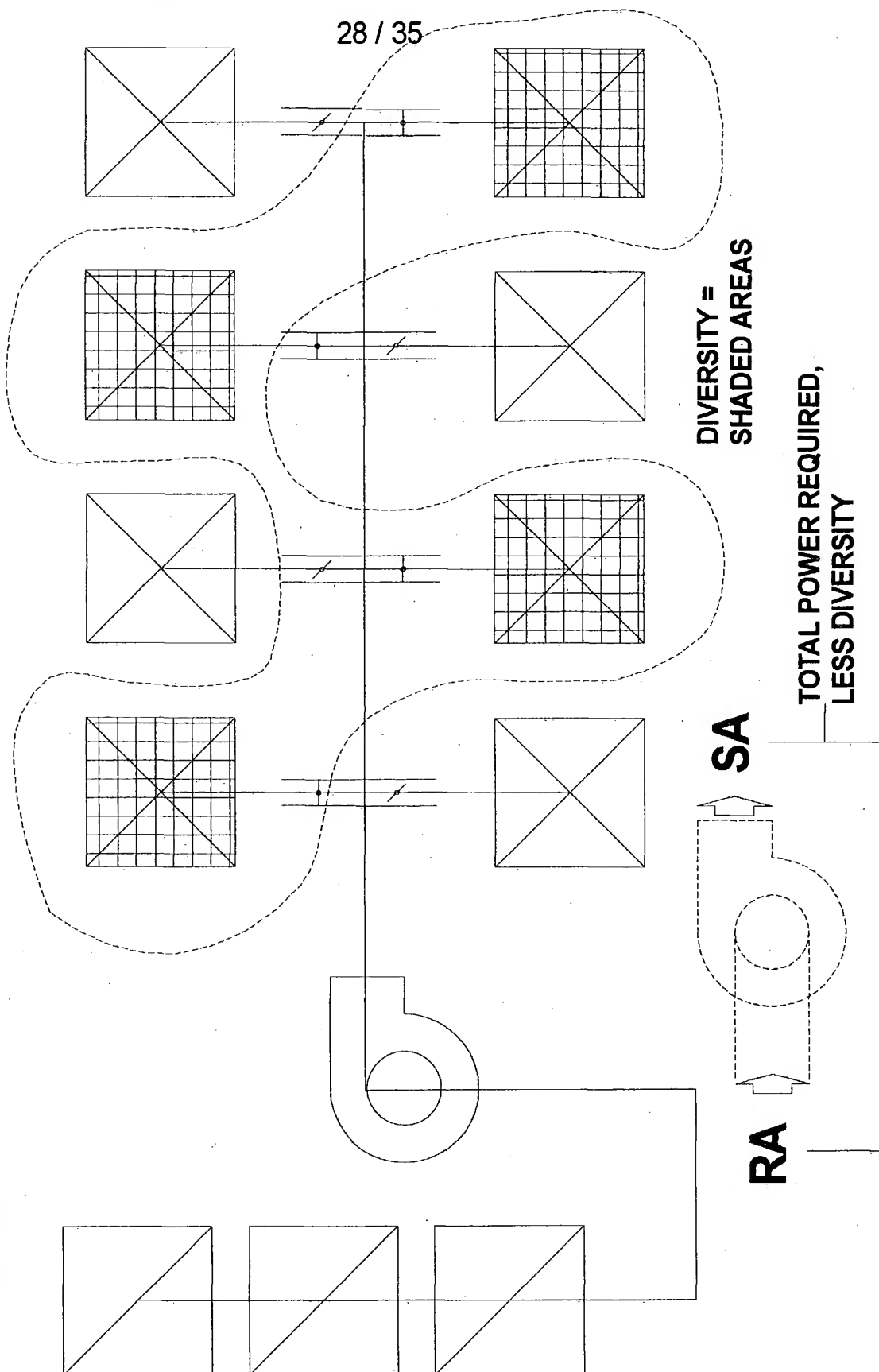


SWITCH TO OR FROM MAIN  
VECTORIAL DISPLAY SCREEN  
REFER TO FIG. 9

SHOWN HERE, A CORRELATIVE EFFECT BETWEEN A TOTAL SYSTEM AND ITS SUB-BRANCH AS THE CHANGE IN ONE AFFECTS THE OTHER, EITHER ADVERSELY OR BENEFICIALLY. THE VECTORIAL ANALYSIS PROVIDES A "BARE BONES" DEPICTION OF EACH SPECIFIC CHANGE EFFECTED IN ONE OR THE OTHER SYSTEM. FOR EXAMPLE, THERE WAS AN X INCREASE IN BHP WHEN A DAMPER WAS CLOSED IN THE SUB-BRANCH.

# SYSTEM DIVERSITY

FIG. 20



**FIG. 21**

**MAIN MENU DISPLAY**

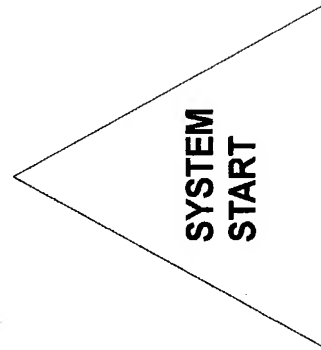
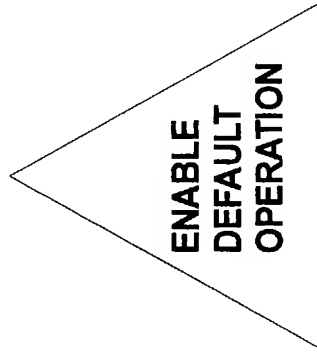
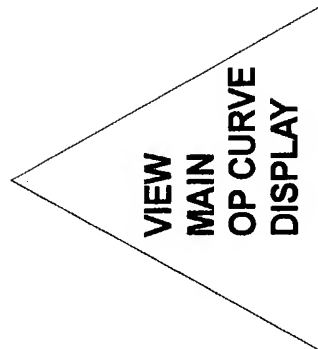
**AIR SYSTEMS (HVAC, NON-HVAC)**

**HYDRONIC SYSTEMS**

**FLUIDIC SYSTEMS**

**GASEOUS SYSTEMS**

**MIXTURES**



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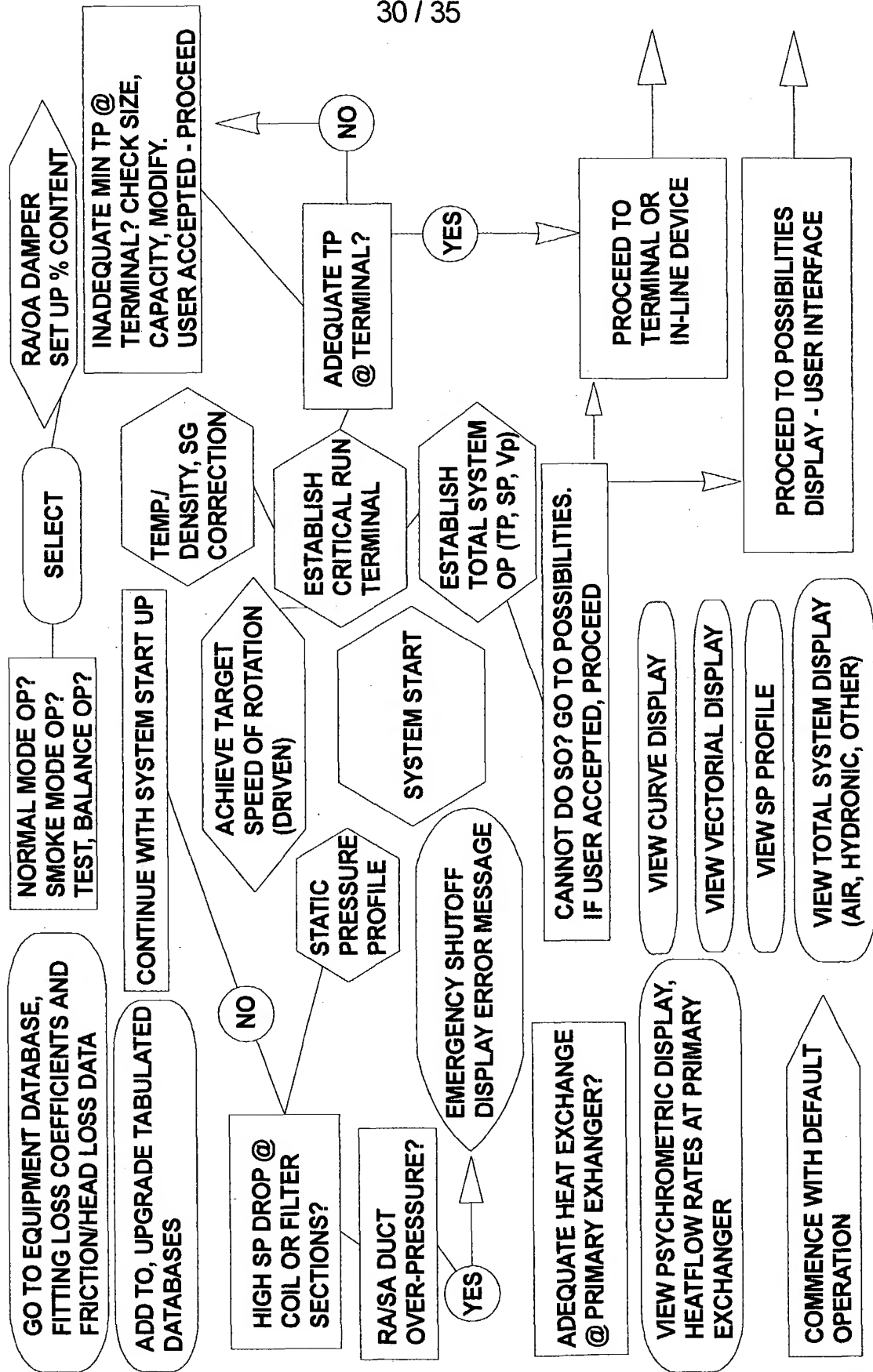
INV. TITLE: FULLY ARTICULATED AND COMPREHENSIVE AIR AND FLUID DISTRIBUTION, METERING, AND CONTROL METHOD AND APPARATUS FOR PRIMARY MOVERS, HEAT EXCHANGERS, AND TERMINAL FLOW DEVICES.

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PHONE: 954-454-3550

# SYSTEM START FLOW CHART (AIR)

FIG. 22



# SYSTEM START FLOW CHART (HYDRONICS)

FIG. 22A

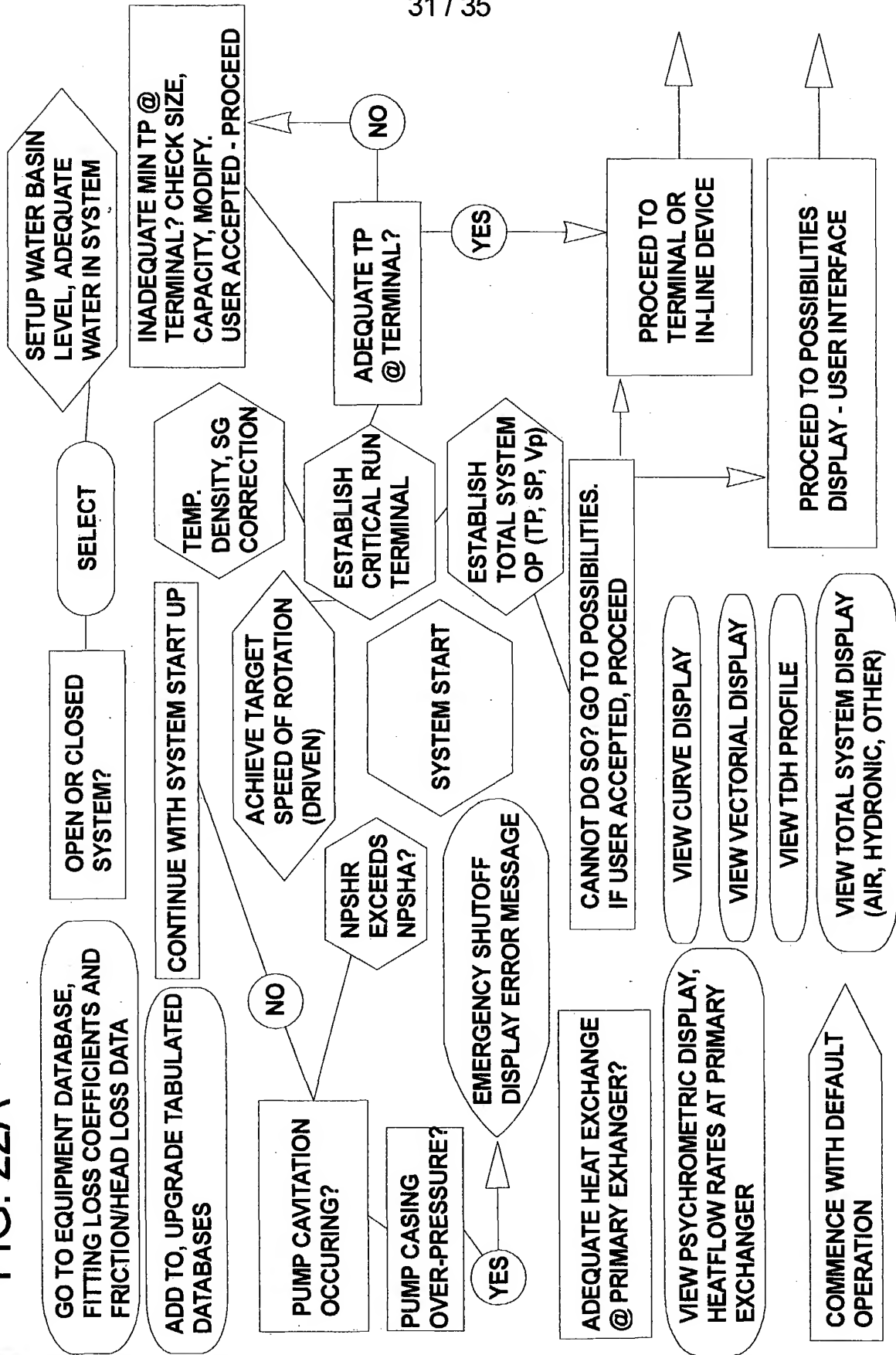
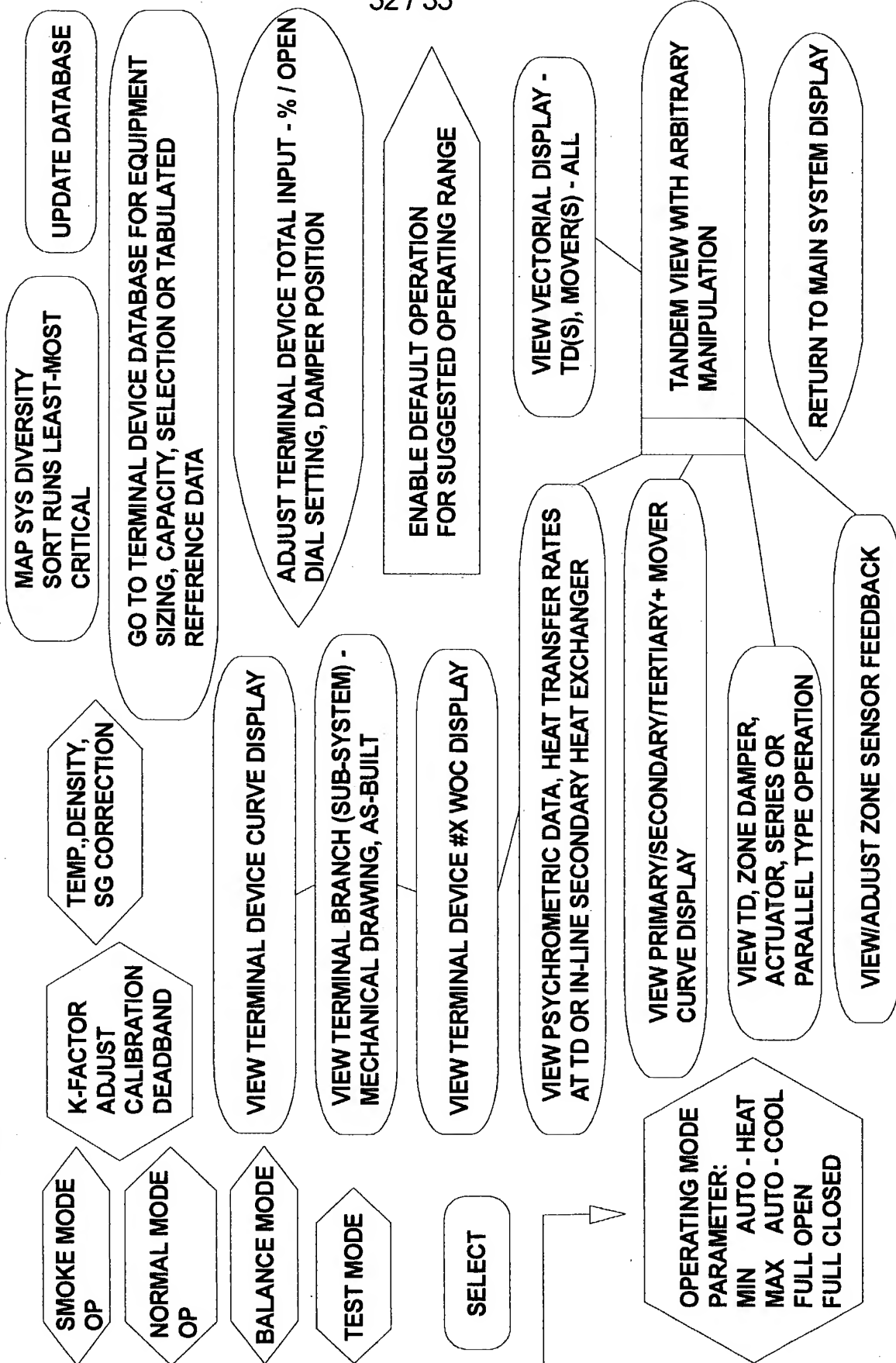


FIG. 22B

# TERMINAL DEVICE FLOW CHART





## FIG. 22C POSSIBILITIES DISPLAY MENU (AIR)

VERIFY THAT THE FOLLOWING CONDITIONS HAVE BEEN MET:

IS THE SYSTEM IN THE CORRECT MODE OF OPERATION?

NORMAL, SMOKE, BALANCE, OR TEST MODE OF OPERATION

ARE ALL DAMPERS/VALVES/TD'S FULLY OPEN OR IN THEIR MAX DESIGN POSITIONS (LESS DIVERSITY) THROUGHOUT THE SYSTEM FOR NORMAL, SMOKE, TESTING, OR BALANCING MODE START UP?

IS MOVES ROTATION CORRECT? MAY REQUIRE PHASE CHANGE

VERIFY THAT MOTOR/DRIVE DATA, TAG, STOCK INFO. IS CORRECT OR APPLY DEFAULT SEARCH OF DATABASE FOR SUITABLE RECOMMENDATION NEEDED TO ACHIEVE OP UNDER CURRENT AS-BUILT CONDITIONS

RA/OA, ECONOMIZER, OR OTHER INTERNAL DAMPERS SET CORRECTLY  
NORMAL OR OTHER MODE OPERATION - % RA/OA

CHECK PACKAGE HOUSING, BLOWER CABINET FOR OBSTRUCTIONS PROBLEM ORIGINATES FROM...?

CLEAN, REPLACE FILTERS

CLEAN COIL FINS, COIL INTERIOR

CHECK REFRIGERANT PRESS./TEMP. IN/OUT

CHECK EXPANSION/CONDENSATION CYCLE,  
HI/LO CUTOUTS, EXPANSION VALVE

SMOKE MODE OPERATION

ARE ALL SMOKE DAMPERS OPEN?

NORMALLY CLOSED / OPEN (WITHOUT POWER)

IS OA DAMPER FULLY OPEN? (100% OA)

IS RA DAMPER FULLY CLOSED? (0% RA)

GO TO MOTOR/DRIVE DATABASE  
(NOT INDEPENDENT OF MOVER)

GO TO SEARCHABLE DATABASE

ADD TO, UPGRADE  
POSSIBILITY DATABASE

TRY SYSTEM RESTART

PROBLEM(S) REMAIN  
RETURN TO POSS  
INTERFACE

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### EXTERNAL PROBLEM:

PROBLEM AT PRIME

MOVER SUCTION,

DISCHARGE?

@ FLOW SENSOR

GRID?

@ TERMINAL OR IN-LINE  
DEVICE?

@ SMOKE DAMPER ON

WALL PARTITION

DUCT SMOKE DETECTOR

OTHER EXTERNAL

DEVICE

### INTERNAL PROBLEM:

MIXING BOX

FILTER SECTION(S) -

FORE / AFT OF MOVER

COIL SECTION(S)

BLOWER SECTION

HUMIDIFIER / UV

OTHER SECTION

TEMP./HEAT EXCHANGE  
PROBLEM

**FIG. 22D**

**POSSIBILITIES DISPLAY MENU (HYDRONICS)**

**VERIFY THAT THE FOLLOWING CONDITIONS HAVE BEEN MET:**

IS THE SYSTEM AN OPEN OR CLOSED SYSTEM?

IS THE SYSTEM IN THE CORRECT MODE OF OPERATION?

ARE ALL VALVES/TD'S FULLY OPEN OR IN THEIR MAX DESIGN POSITIONS (LESS DIVERSITY) THROUGHOUT THE SYSTEM FOR NORMAL, TESTING, OR BALANCING MODE START UP?

IS MOVER ROTATION CORRECT? MAY REQUIRE PHASE CHANGE

VERIFY THAT MOTOR/DRIVE DATA, TAG, STOCK INFO. IS CORRECT OR APPLY DEFAULT SEARCH OF DATABASE FOR SUITABLE RECOMMENDATION NEEDED TO ACHIEVE OP UNDER CURRENT AS-BUILT CONDITIONS

**OPEN SYSTEM**

DOES THE SYSTEM HAVE SUCTION LIFT, I.E., PIPING BELOW PUMP CENTERLINE?

DOES THE SYSTEM HAVE ADEQUATE NPSH?

IS WATER BASIN LEVEL BEING MAINTAINED?

IS THERE ADEQUATE MAKEUP WATER?

IS THERE ADEQUATE WATER IN THE SYSTEM AT HIGHEST POINT IN PIPING?

**CLOSED SYSTEM**

IS THERE ADEQUATE WATER IN THE SYSTEM AT HIGHEST POINT IN PIPING?

HYDRONICS TERMINAL COIL PROBLEM:

COIL CHW IN HAS CORRECT TEMP., BUT NO FLOW/TEMP. SENSED CHW OUT? AERATE COIL

GO TO MOTOR/DRIVE DATABASE  
(NOT INDEPENDENT OF MOVER)

GO TO SEARCHABLE DATABASE

ADD TO, UPGRADE  
POSSIBILITY DATABASE

TRY SYSTEM RESTART

PROBLEM(S) REMAIN  
RETURN TO POSS  
INTERFACE

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**PROBLEM ORIGINATES FROM...?**

**EXTERNAL PROBLEM:**

PROBLEM AT PRIME

MOVER SUCTION,

DISCHARGE?

@ FLOW SENSOR

GRID?

@ TERMINAL OR IN-LINE

DEVICE?

OTHER EXTERNAL

DEVICE

**INTERNAL PROBLEM:**

PUMP CASING

IMPELLER

STRAINER SECTION(S)

FORE / AFT OF MOVER

OTHER INT. SECTION

TEMP/HEAT EXCHANGE  
PROBLEM

# INDEPENDENT SYSTEM CURVES (PRESSURE / HEAD)

FIG. 23

